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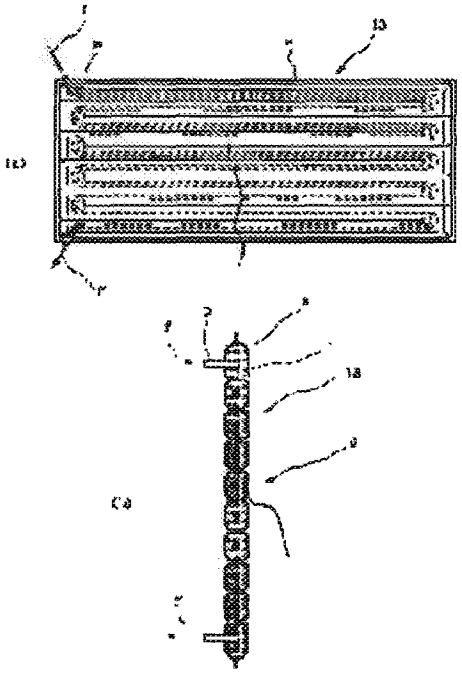
(54) HEAT EXCHANGER FOR REGULATING TEMPERATURE OF OBJECT, PROJECTION LENS MANUFACTURED USING IT, AND APPARATUS COMPRISING OPTICAL SYSTEM USING IT

(57)Abstract:

PROBLEM TO BE SOLVED: To control the surface temperature of a unit constituting a semiconductor production system with high accuracy using a liquid as a heating medium and employing a temperature regulation jacket which can be removed easily at the time of maintenance.

SOLUTION: The heat exchanger comprises a tube p forming a channel for passing a temperature controlled liquid f, and a thermal conduction member comprising a filler j and a resin sheet s for transferring heat between the temperature controlled liquid f and an object to be temperature controlled, e.g. a projection lens. The tube p and a part or the entirety of the thermal conduction member employ a removable temperature regulation jacket 13 having a specified flexibility. The temperature regulation jacket 13 surrounds a side wall constituting the object to be temperature controlled when it is fixed thereto and the jacket 13 can be developed into an elongated stripe or planar shape upon removal.



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CLAIMS

[Claim(s)]
[Claim 1] It has the heat-conduction member which transmits heat between the passage which pours the liquid by which temperature control was carried out, and this liquid by which temperature control was carried out and a temperature control-ed object. And it has the passage which pours this liquid, and the temperature control jacket of a heat-conduction member in which a part of either [at least] has flexibility at least. Heat exchange equipment for body temperature control characterized by having a liquid feeder style for supplying the liquid by which temperature control was carried out to the passage which said temperature control-ed object is equipped with this temperature control jacket removable, and pours said liquid.
[Claim 2] Heat exchange equipment for body temperature control according to claim 1 characterized by the ability of said temperature control jacket removed from said temperature control-ed object to develop in the shape of an approximate plane.
[Claim 3] Heat exchange equipment for body temperature control according to claim 2 characterized by arranging said temperature control jacket spirally in contact with said temperature control-ed object front face.
[Claim 4] Heat exchange equipment for body temperature control according to claim 2 or 3 characterized by arranging a heat-conduction promotion member in the field which counters said temperature control-ed object front face of said temperature control jacket.
[Claim 5] Heat exchange equipment for body temperature control according to claim 4 characterized by said heat-conduction promotion member becoming by graphite.
[Claim 6] Heat exchange equipment for body temperature control according to claim 2 characterized by arranging a magnetic member in the field of said temperature control jacket which counters said temperature control-ed object front face.
[Claim 7] Heat exchange equipment for body temperature control according to claim 6 characterized by said magnetic member being a rubber magnet.
[Claim 8] Heat exchange equipment for body temperature control according to claim 2 characterized by arranging a heat insulator in the field of said temperature control jacket and the field of the opposite side which counter said temperature control-ed object front face.
[Claim 9] Heat exchange equipment for body temperature control according to claim 1 or 2 characterized by a part of passage [at least] which pours said liquid with which said temperature control jacket was equipped being flexible tubing.
[Claim 10] Heat exchange equipment for body temperature control according to claim 1 or 2 characterized by the heat-conduction member with which said temperature control jacket was equipped becoming with the saccate sheet which encloses a bulking agent and this bulking agent.
[Claim 11] Heat exchange equipment for body temperature control according to claim 10 characterized by being either although said saccate sheet comes to **** resin, a metal thin film, and resin and a metal thin film.
[Claim 12] It is heat exchange equipment for body temperature control according to claim 10 or 11 characterized by for the break and the divided building envelope having made the airtight space inside said saccate sheet open for free passage mutually, and enclosing a filler with the interior of this space.
[Claim 13] Heat exchange equipment for body temperature control according to claim 10 or 11

which divides said interior of a saccate sheet into two or more airtight space, and is characterized by enclosing a bulking agent with each divided space.
[Claim 14] The interior of the tube as passage which pours said at least one or more liquids is carried out to said saccate sheet. The entrance of this tube is heat exchange equipment for body temperature control given in either of claims 10, 12, or 13 characterized by enclosing a bulking agent between said tubes by which the exterior of said saccate sheet was made to penetrate with the airtight inside this saccate sheet held, and interior was carried out to this saccate sheet.
[Claim 15] Heat exchange equipment for body temperature control according to claim 14 characterized by for the tube as passage which pours said liquid having moved on said saccate sheet in a zigzag direction, and carrying out interior to it.
[Claim 16] Heat exchange equipment for body temperature control given in either of claims 10, 12, or 13 characterized by the thing of the outside surface of said saccate sheet arranged at least so that the whole surface might be touched in at least one or more tubes.
[Claim 17] Heat exchange equipment for body temperature control according to claim 16 characterized by for the tube as passage which pours said liquid having moved on said saccate sheet in a zigzag direction, and carrying out sheathing to it.
[Claim 18] Saccate isomorphism-like 2nd sheet is prepared mostly. the 1st saccate sheet with which the bulking agent was enclosed, and a bulking agent were enclosed -- Heat exchange equipment for body temperature control according to claim 10 to 17 characterized by arranging at least one or more tubes so that the outside surface of each of this saccate sheet of two sheets may be touched, and sticking the saccate sheet of two sheets mutually.
[Claim 19] Heat exchange equipment for body temperature control according to claim 18 characterized by for the tube as passage which pours said liquid having moved in a zigzag direction, and being arranged between said saccate sheets of two sheets.
[Claim 20] Heat exchange equipment for body temperature control according to claim 14 to 17 characterized by being parallel in at least two or more tubes, and pouring a liquid for the inside of interior or each tube which is made to carry out sheathing and adjoins each other to hard flow at said saccate sheet, respectively.
[Claim 21] The heat-conduction member with which said temperature control jacket was equipped is heat exchange equipment for body temperature control according to claim 1 or 2 characterized by being two or more blocks which the passage which pours said at least one or more liquids is formed, and have a curvature side almost equivalent to the curvature of a temperature control object front face in the whole surface at least.
[Claim 22] Heat exchange equipment for body temperature control according to claim 21 characterized by connecting each of a block of said plurality by the tube as passage which pours said at least one or more liquids.
[Claim 23] Heat exchange equipment for body temperature control according to claim 22 characterized by connecting said two or more blocks with the connection sheet of at least one or more sheets.
[Claim 24] Heat exchange equipment for body temperature control according to claim 23 with which said connection sheet is characterized by the thing of a heat-conduction promotion member and a magnetic material become by either at least.
[Claim 25] Said heat-conduction member is heat exchange equipment for body temperature control according to claim 1 or 2 characterized by being two or more plates which the passage which pours said at least one or more liquids is formed in contact with the outer wall, and have a curvature side almost equivalent to the curvature of a temperature control object front face.
[Claim 26] Heat exchange equipment for body temperature control according to claim 25 characterized by said plate becoming by either the looping capillary heat pipe and graphite.
[Claim 27] Heat exchange equipment for body temperature control according to claim 25 characterized by connecting each of two or more of said plates by the tube as passage which pours said at least one or more liquids.
[Claim 28] Heat exchange equipment for body temperature control according to claim 27 characterized by connecting said two or more plates with the connection sheet of at least one or more sheets.
[Claim 29] Heat exchange equipment for body temperature control according to claim 1

characterized by a temperature control-ed object being a projection lens.
[Claim 30] Heat exchange equipment for body temperature control according to claim 1 to 27 characterized by having the temperature of said liquid, and a temperature control means of said temperature control object to control one of temperature at least.
[Claim 31] Equipment possessing the optical system of the semiconductor fabrication machines and equipment which used the heat exchange equipment for body temperature control according to claim 1 to 30, test equipment, or the measuring devices.
[Claim 32] The projection lens characterized by being manufactured using the heat exchange equipment for body temperature control according to claim 1 to 30.
[Claim 33] The aligner characterized by providing the projection lens manufactured using the heat exchange equipment for body temperature control according to claim 1 to 30.
[Claim 34] The semiconductor device manufacture approach characterized by having the process which installs the manufacturing installation group containing an aligner according to claim 33 for [various] processes in a semi-conductor plant, and the process which manufactures a semiconductor device by multiple processes using this manufacturing installation group.
[Claim 35] The semiconductor device manufacture approach according to claim 34 characterized by having further the process which connects said manufacturing installation group in a Local Area Network, and the process which carries out data communication of the information about at least one set of said manufacturing installation group between said Local Area Networks and external networks besides said semi-conductor plant.
[Claim 36] The semiconductor device manufacture approach according to claim 35 characterized by carrying out data communication through said external network between semi-conductor plants other than said semi-conductor plant, and performing production control or it accesses the database which the vendor or user of said aligner offers through said external network and acquires the maintenance information on said manufacturing installation by data communication.
[Claim 37] The semi-conductor plant characterized by making it possible to have the gateway made accessible and to carry out data communication of the information about at least one set of said manufacturing installation group in the external network outside works from the Local Area Network which connects the manufacturing installation group and this manufacturing installation group for [containing an aligner according to claim 33 / various] processes, and this Local Area Network.
[Claim 38] The process which it is the maintenance procedure of the aligner according to claim 33 installed in the semi-conductor plant, and the vendor or user of said aligner provides with the maintenance database connected to the external network of a semi-conductor plant, The process to which access to said maintenance database is permitted through said external network from the inside of said semi-conductor plant, The maintenance procedure of the aligner characterized by having the process which transmits the maintenance information accumulated in said maintenance database to a semi-conductor plant side through said external network.
[Claim 39] The aligner characterized by making it possible to have further a display, a network interface, and the computer that performs software for networks in an aligner according to claim 33, and to carry out data communication of the maintenance information on an aligner through a computer network.
[Claim 40] Said software for networks is an aligner according to claim 39 characterized by making it possible to offer the user interface for accessing the maintenance database which connects with the external network of the works in which said aligner was installed , and the vendor or user of said aligner offers on said display , and to acquire information from this database through said external network .

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention uses for the projection aligner equipped with the production process of the projection optics manufactured using a temperature controller in a detail further, and the temperature controller for projection optics about the aligner used in order to manufacture the semi-conductor test equipment which performs highly precise optical measurement especially, a measuring device, and a semiconductor integrated circuit and a liquid crystal panel about the heat exchange equipment for body temperature control which requires high temperature stability and temperature control nature and is suitable.
[0002]
[Description of the Prior Art] Detailed-ization of semiconductor integrated circuit line breadth progresses, and, now, formation of the line breadth pattern of the base of 0.1 micrometers is being realized on mass-production level. In order to form this detailed pattern, the highly precise image formation engine performance and superposition precision are demanded of the projection aligner. In the superposition precision of the reticle of an aligner, and a wafer, the length measurement precision of the wafer stage location in which a wafer is carried is set to one of the very important noise factors. It is common to precision length measurement of this location to use a laser interferometer type length measuring machine, and refractive-index change of a laser beam way ambient atmosphere, especially a temperature change have a bad influence on a length measurement error. Moreover, the delicate heat deformation resulting from temperature fluctuation of the structure which fixes the interferometer which is the configuration member of a laser interferometer type length measuring machine, and a reflecting mirror also has a bad influence on this length measurement error. Otherwise, it is started according to heat deformation of the structure to which fluctuation of the distance between an off-axis alignment microscope and projection optics supports each in off-axis alignment, and heat deformation of this structure has become the factor which degrades superposition precision. On the other hand, since the refractive index of gases, such as a refractive index of the ** material which uses for a lens the projection optics which accumulates two or more single lenses at the predetermined spacing, and changes, and air which exists in the opening between lenses, the die length of the structural material which holds lens spacing uniformly, etc. change with temperature, the image formation engine performance of projection optics of a scale factor, a focus, and an image, such as distortion, changes with ambient temperature sensitively.
[0003] Besides the projection aligner, the laser interferometer is used also in the field configuration measuring device for measuring the shape of surface type of the reticle coordinate measuring device for measuring superposition test equipment, the dimension of the pattern on a reticle, etc., a body, especially an optical member, and heat deformation of the temperature change of a laser beam way ambient atmosphere and the structure had become the factor which degrades the measurement precision of these equipments.
[0004] For this reason, with equipment including the optical system of the conventional projection aligner, a semi-conductor test equipment, a measuring device, etc., etc., the whole equipment, its part, or its both are surrounded by the environmental chamber by which temperature control was carried out, and controlling uniformly the environmental temperature on which equipment is put is performed positively.

[0005] Drawing 20 is an example of the conventional aligner. On the body of an aligner, after the light injected from the non-illustrated exposure light source is formed in the flux of light predetermined by the illumination-light study system 1, a reticle 2 is irradiated. Image formation of the circuit pattern on the irradiated reticle 2 is carried out on the wafer 4 laid on the wafer stage 5 with the projection lens 3, and it exposes the resist applied to the front face of a wafer 4. Moreover, the stanchion 9 which supports the laser interferometer 8 for measuring the location of the criteria mirror 7 laid on the off axis microscope 6 for observing and location measuring the alignment mark the projection lens 3 and on a wafer 4 and the wafer stage 5 and the wafer stage 5 and it, and the light source 10 further for laser interferometers are concluded directly or indirectly by the structure 12 of the body of an aligner.
[0006] Moreover, the body of an aligner is installed into the non-illustrated environmental chamber, and the environment which surround an aligner is maintained at predetermined temperature. Moreover, blowing the air-conditioning air by which temperature control was further carried out according to the individual into the space which surrounds the wafer stage 5 and an interferometer 8, and the space which surrounds the projection lens 3, and maintaining environmental temperature with high precision more was carried out if needed.
[0007]
[Problem(s) to be Solved by the Invention] However, if a projection aligner is taken for an example, in the structure of the body of a projection aligner which supports projection optics, an interferometer, an off-axis alignment microscope, etc., or its perimeter, it will become a difficult situation to maintain the laser light source for laser interference comparators, various electric substrates, and the temperature precision that sources of generation of heat, such as an actuator for a drive, exist further, and projection optics tends to be influenced [the], and is required of superposition precision or projection optics in control of the air-conditioning temperature of an environmental chamber. 0.1 degrees C - about 0.2 degrees C of structures of for example, not only the effect by heat transfer from the air warmed according to the perimeter heat source but the body of a projection aligner became higher than the laying temperature of an environmental chamber under the effect of these heat sources, the equivalent temperature gradient occurred compared with the perimeter environment by heat conduction from the structure itself, and the projection optics supported directly or indirectly by this structure had the problem that the predetermined image formation engine performance was not obtained. Since the temperature of this structure furthermore changed with the operation situations of a perimeter heat source and delicate heat deformation with the passage of time occurred in this structure, the location of the interferometer supported more directly than this structure or indirectly, an off axis microscope, etc. shifted, and it had become the cause of making superposition precision generating an error. There was a case where heat deformation of the off axis microscope itself with the passage of time furthermore became the cause of making superposition precision generating an error.
[0008] Moreover, before including projection optics in the body of a projection aligner, it assembles a projection optics simple substance as one unit, and changes through the process to adjust. At the process which adjusts this projection optics simple substance, carrying projection optics in the aligner like a tool and transmitted wave side measuring device as a production facility, and checking the actual image formation engine performance, the adjustment approach is chosen and the amount of adjustments is computed so that the predetermined image formation engine performance may be obtained based on it. However, in the condition of having been carried in this aligner like a tool, or a transmitted wave side measuring device through various adjustment processes, when the projection exposure system from which the predetermined image formation engine performance was obtained was carried in the structure of the body of a projection aligner, the image formation engine performance in a simple substance did not reappear, but there was a problem that the predetermined engine performance was not obtained. When this phenomenon was investigated, it became clear that it was the cause of main that the temperature of the projection optics in the condition of having been carried in the aligner like a tool or the transmitted wave side measuring device differs from the temperature in the condition of having been carried in the body of a projection aligner, by the average or distribution.
[0009] As it is in invention given in JP,09-082621,A as an approach of controlling projection optics

to predetermined temperature here, it is possible to form passage in a projection optics lens-barrel side attachment wall, and to pour the liquid by which temperature control was carried out. However, forming passage in this lens-barrel side attachment wall had the fault to which the cost of components becomes very high. Furthermore, at the adjustment process of a projection optics unit, occasionally two or more lens groups held in projection optics are rotated, or the activity which decomposes the projection optics of changing lens spacing occasionally follows. When liquid passage was formed in the side attachment wall of a projection optics lens-barrel, whenever it performed the adjustment process accompanied by these decomposition activity, the liquid which remains in this passage was removed and there was a fault that the productivity of projection optics got worse, with the excessive activity which decomposes the passage itself.

[0010] Moreover, the interferometer laser head and the electric base which can serve as a heat source which applies temperature control with this liquid and affects superposition precision, As opposed to both [both / either or] the structure and the off-axis alignment microscope which produce heat deformation under various members, such as an actuator for a drive, or the thermal effect of those, and an interferometer Form passage in these side attachment walls, and although suppressing temperature fluctuation by pouring the liquid by which temperature control was carried out to this passage is considered easily When the cost of components became very high and internal repair and an internal maintenance were performed, actually forming passage in the interior of these side attachment walls removed the liquid which remains in this passage one by one, and it had the fault that the productivity of a projection aligner got worse, with the excessive activity which decomposes the passage itself.

[0011] This invention aims at offering the heat exchange equipment for body temperature control which carries out temperature control of the front faces, such as an optical-system unit which constitutes semiconductor fabrication machines and equipment, with high precision, and has a temperature control jacket through a removable liquid easily in the cases, such as a maintenance.

[0012]

[Means for Solving the Problem] In order to solve the above-mentioned problem, with the heat exchange equipment for body temperature control concerning this invention It has the heat-conduction member which transmits heat between the passage which pours the liquid by which temperature control was carried out, and this liquid by which temperature control was carried out and a temperature control-ed object. And it has the passage which pours this liquid, and the temperature control jacket of a heat-conduction member in which a part of either [at least] has flexibility at least. Said temperature control-ed object is equipped with this temperature control jacket removable, and it is characterized by having a liquid feeder style for supplying the liquid by which temperature control was carried out to the passage which pours said liquid.

[0013] As for said temperature control jacket removed from said temperature control-ed object, it is desirable that it can develop in the shape of an approximate plane, it is good also as arranging said temperature control jacket spirally in contact with said temperature control-ed object front face, a heat-conduction promotion member may be arranged in the field which counters said temperature control-ed object front face of said temperature control jacket, and, as for said heat-conduction promotion member, becoming by graphite is desirable.

[0014] Moreover, this invention may arrange a magnetic member in the field of said temperature control jacket which counters said temperature control-ed object front face, it is desirable for said magnetic member to be a rubber magnet, and it is desirable to arrange a heat insulator in the field of said temperature control jacket and the field of the opposite side which counter said temperature control-ed object front face.

[0015] Moreover, as for this invention, it is desirable for a part of passage [at least] which pours said liquid with which said temperature control jacket was equipped to be flexible tubing. It is desirable that the heat-conduction member with which said temperature control jacket was equipped becomes with the saccate sheet which encloses a bulking agent and this bulking agent. Said saccate sheet You may be any although it comes to **** resin, a metal thin film, and resin and a metal thin film. It is good also as a break and the divided building envelope making the airtight space inside said saccate sheet open for free passage mutually, and enclosing a filler with the interior of this space, and good also as dividing said interior of a saccate sheet into two or more airtight space, and

enclosing a bulking agent with each divided space.
[0016] Moreover, the interior of the tube as passage which pours said at least one or more liquids is carried out to said saccate sheet. The exterior of said saccate sheet is made to penetrate the entrance of this tube, with the airtight inside this saccate sheet held. It is desirable to enclose a bulking agent between said tubes by which interior was carried out to this saccate sheet. It is desirable for the tube as passage which pours said liquid to move on said saccate sheet in a zigzag direction, and to carry out interior to it. You may arrange so that the whole surface may be touched in at least one or more tubes, even if there are few outside surfaces of said saccate sheet. The 1st saccate sheet with which the tube as passage which pours said liquid moved on said saccate sheet in a zigzag direction, sheathing could be carried out to it, and the bulking agent was enclosed, Saccate isomorphism-like 2nd sheet is prepared mostly. the bulking agent was enclosed -- at least one or more tubes Are good also considering arranging so that the outside surface of each of this saccate sheet of two sheets may be touched, and having stuck the saccate sheet of two sheets mutually as a description. Are good also considering the tube as passage which pours said liquid having moved in a zigzag direction, and having been arranged between said saccate sheets of two sheets, as a description. It is desirable for it to be parallel in at least two or more tubes, and to pour a liquid for the inside of interior or each tube which is made to carry out sheathing and adjoins each other to hard flow to said saccate sheet, respectively.
[0017] Moreover, the heat-conduction member with which said temperature control jacket was equipped It is desirable that they are two or more blocks which the passage which pours said at least one or more liquids is formed, and have a curvature side almost equivalent to the curvature of a temperature control object front face in the whole surface at least. Each of a block of said plurality may be connected by the tube as passage which pours said at least one or more liquids, and said two or more blocks may be connected with the connection sheet of at least one or more sheets. As for said heat-conduction member, it is desirable that they are two or more plates which the passage which pours said at least one or more liquids is formed in contact with the outer wall, and have a curvature side almost equivalent to the curvature of a temperature control object front face. Moreover, this invention is good also as said plate becoming by either the looping capillary heat pipe and graphite. It is possible to connect each of two or more of said plates by the tube as passage which pours said at least one or more liquids. It is desirable to connect said two or more plates with the connection sheet of at least one or more sheets, to be able to suppose that a temperature controlled object is a projection lens, and to have the temperature of said liquid and a temperature control means of said temperature control object to control one of temperature at least.
[0018] Moreover, the heat exchange equipment for body temperature control concerning this invention can be used also for the equipment possessing which optical system of semiconductor fabrication machines and equipment, test equipment, and a measuring device, a projection lens can also be manufactured using the heat exchange equipment for body temperature control concerning this invention, and this invention also contains the aligner possessing the projection lens manufactured using the heat exchange equipment for body temperature control concerned.
[0019] Moreover, the process which installs the manufacturing installation group for [various] processes in which this invention contains said aligner in a semi-conductor plant, The process which can apply also to the semiconductor device manufacture approach of having the process which manufactures a semiconductor device by multiple processes using this manufacturing installation group, and connects said manufacturing installation group in a Local Area Network, Between said Local Area Networks and external networks besides said semi-conductor plant The process which carries out data communication of the information about at least one set of said manufacturing installation group is applicable also to the semiconductor device manufacture approach which it has further. Access the database which the vendor or user of said aligner offers through said external network, and acquire the maintenance information on said manufacturing installation by data communication. Or it is applicable also to the semiconductor device manufacture approach of carrying out data communication through said external network between semi-conductor plants other than said semi-conductor plant, and performing production control.
[0020] Moreover, the manufacturing installation group for [various] processes in which this invention contains said aligner, It has the gateway made accessible to the external network outside

works from the Local Area Network which connects this manufacturing installation group, and this Local Area Network. Are applicable to the semi-conductor plant which made it possible to carry out data communication of the information about at least one set of said manufacturing installation group. The process which it is the maintenance procedure of said aligner installed in the semi-conductor plant concerned, and the vendor or user of said aligner provides with the maintenance database connected to the external network of a semi-conductor plant, The process to which access to said maintenance database is permitted through said external network from the inside of said semi-conductor plant, Can apply also to the maintenance procedure of the aligner which has the process which transmits the maintenance information accumulated in said maintenance database to a semi-conductor plant side through said external network, and it sets to this aligner. It is desirable to make it possible to have further a display, a network interface, and the computer that performs software for networks, and to carry out data communication of the maintenance information on an aligner through a computer network.

[0021] As for said software for networks, it is desirable to make it possible to offer the user interface for accessing the maintenance database which connects with the external network of the works in which said aligner was installed, and the vendor or user of said aligner offers on said display, and to acquire information from this database through said external network.

[0022]

[The gestalt of implementation of invention, and an operation] Said temperature control jacket serves as a form which surround the side attachment wall which constitutes the temperature control-ed object, where a temperature control-ed object is equipped. For example, when this temperature control-ed object is projection optics, a cylindrical shape or approximate circle drill type, band-like [long and slender when becoming one form of both combination further and removing], and the lens-barrel section is characterized by becoming the form where flat-surface expansion or two or more radii configurations were opened, about the cylindrical shape or approximate circle drill type used as hollow so that that lens-barrel side attachment wall may be surrounded. Moreover, in the case of the structure of the body of a projection aligner, an off-axis alignment microscope, etc., this temperature control-ed object serves as the form where are a flat-surface configuration or a box-like object is wrapped, for example. In the case of the form where a box-like object is wrapped, it is characterized by the configuration which carried out flat-surface expansion of the 2nd [or more] page of this box-like object at least, using the temperature control jacket of a flat-surface configuration two or more.

[0023] Moreover, the passage over both of the line divided by expansion at this time is not formed. Moreover, it has the member which combines both bordering on this divided line, and has the structure where the attachment and detachment to a temperature control-ed object can be performed easily.

[0024] The temperature of the liquid supplied by the liquid feeder style based on the temperature which a temperature sensor may furthermore be formed in the interior of this temperature control jacket if needed, and was detected by the temperature sensor is controlled by the temperature control means.

[0025] In order to make small the temperature gradient produced with feeding-and-discarding heat, heat capacity is comparatively large into the liquid by which temperature control was carried out, and what has small piping resistance is [that it is easy to pass] good for it. When passage passes near the electric system, in order to suppress the accident at the time of a liquid spill to the minimum, it is desirable that it is an insulating liquid. Specifically, water, pure water, a propylene glycol water solution, and fluoridation liquid can be considered. Moreover, in order to suppress the failure at the time of a liquid spill, and danger to the minimum, in addition, it is good to form the sensor for liquid spill detection in the outside surface of passage which pours the front face and the liquid by which temperature control was carried out of this temperature control jacket. Various configurations can be considered in this temperature control jacket.

[0026] The flexibility airtight sheet which comes to compound a resin sheet, or a metal thin film and a resin sheet is formed in saccate [with the shape of a rectangle or a sector], and it is filled up with a heat-conduction ingredient into this. What is easy to imitate forms of the container which is the matter with large heat capacity with high thermal conductivity comparatively, and was put in further,

such as polymer gel which comes to mix polymeric materials with liquids, such as pure water, a fluoridation liquid, a propylene glycol water solution, and silicone oil, the water currently used for the cold insulator etc., or an oil as a heat-conduction ingredient, and a liquid metal further represented by mercury, is good. It is desirable for the filled heat-conduction ingredient to serve as a form sealed with this flexibility airtight sheet, and to make it air not enter if possible. The passage which pours the liquid by which temperature control was carried out so that this heat-conduction ingredient might be touched is formed in said flexibility airtight sheet. The resin tube metallurgy group tube simply bent in this passage is used, and it is arranged at homogeneity at the whole flexibility airtight sheet, going and moving in a zigzag direction at right and left or the upper and lower sides. Making at least one continuous tube go and move in a zigzag direction, that what is necessary is just to make it arrange on a flexibility airtight sheet, in this case, every one outlet and inlet port of a liquid by which temperature control was carried out are open for free passage to the both ends of this winding passage, and are prepared out of the flexibility airtight sheet.

[0027] Moreover, when this passage is long, it is possible on the temperature control of projection optics that the temperature gradient in the entrance of a liquid cannot be disregarded. In this case, it is made to arrange on a flexibility airtight sheet, making it go and move in a zigzag direction, after making two continuous tubes adjoin each other, and every two entrances of the liquid by which temperature control was carried out are prepared out of a saccate sheet. When a metaphor prepares two entrances at a time caudad with the upper part of a saccate sheet, as for one side of the tube inside the airtight sheet which is open for free passage to it, a sink and the tube of another side pour the liquid by which temperature control was carried out [lower part] to the inlet port by considering as an outlet in the upper part to the outline upper part at an outline lower part for the liquid by which temperature control was carried out [upper part] to the inlet port by considering as an outlet in the lower part. That is, the effectiveness of negating the temperature gradient of an entrance mutually is expectable by making reverse mutually the direction where the liquid within two adjacent tubes flows. Moreover, apart from this, the tube taken about inside a flexibility airtight sheet may be beforehand set as the die length which is extent which can disregard the temperature gradient of an entrance, and you may constitute from an entrance corresponding to two or more tubes and the number of those.

[0028] Moreover, when temperature control-ed objects are cylinders and cone configurations, such as a projection optics lens-barrel, it considers as the temperature control jacket which formed the configuration of a flexibility saccate sheet in band-like [with width of face wider than the flexibility tube which is the passage of the liquid which it lets pass inside, and by which temperature control was carried out], and twisting this band-like temperature control jacket spirally in accordance with the outer wall of a projection optics lens-barrel is also considered.

[0029] Moreover, it has two or more blocks which prepared the curvature almost same otherwise as the curvature of the outer wall of a projection optics lens-barrel with a cylinder or a cone configuration in the whole surface at least, and the passage which pours at least one liquid by which temperature control was carried out is formed in the interior of this block. The flexibility tube is connected to the entrance of the passage of this block end face, and two or more blocks are made to connect mutually with this flexibility tube. The form in the condition of having extended two or more blocks mutually connected with this flexibility tube at the flat surface serves as the shape of the shape of band-like [long and slender] and a rectangle put in order in all directions, or a sector. This is twisted around a projection optics lens-barrel outer wall spirally or annularly, and it fixes by the holddown member. By making it a flat surface, the curvature prepared in the whole surface of this block can also be used as the structure or off-axis microscopes. What is necessary is just to constitute two or more number in all of the entrances as the passage and the whole of a flexibility tube and the liquid which consists of passage within a block and by which temperature control was carried out furthermore for the temperature control precision needed [temperature distribution / the touch area / object / temperature control-ed / of a block,].

[0030] Moreover, it is desirable that it is the comparatively large metal of thermal conductivity or heat capacity, and if this block is the alloy which made aluminum, copper, or it the principal member, in addition, it is good.

[0031] Moreover, otherwise, said block may be transposed to a plate with the almost same curvature

as the curvature of the outer wall of a temperature control-ed object, it may prepare so that piping which serves as passage on the outside of this plate may be contacted, and you may make the shape of band-like [said / long and slender] and a rectangle put in order in all directions, and in the shape of a sector with two or more plates which connected the both ends of this piping with the flexibility tube. As for a plate, it is desirable that they are comparatively large metals of thermal conductivity, such as an alloy which made aluminum, copper, or it the principal member. Of course, this curvature may be a flat surface.

[0032] Moreover, when the thermal conductivity of the direction of a flat surface constitutes a large heat-conduction promotion member compared with the thickness direction in the field in contact with the temperature control-ed object side attachment wall of the temperature control jacket of these versatility, temperature control nature, especially the temperature homogeneity of the temperature control-ed object side attachment wall at the time of wearing can be raised.

[0033] As a heat-conduction promotion member, there are a graphite sheet and a tabular looping capillary heat pipe. In addition, since raising dust may be carried out from a front face, the graphite sheet itself should just cover the outermost side with another resin or a metal thin film, when avoiding this.

[0034] Moreover, although the temperature control-ed object was used as projection optics, the structure, and an off-axis alignment microscope here, you may use as the temperature control means and cooling means of the heat source which has a bad influence on superposition precision and image formation engine performance, such as an interferometer laser head with which it is dotted on the body structure of a projection aligner, or the outskirts of it, and various electric substrates. It is also possible to arrange magnetic members, such as a rubber magnet, in the field which counters the temperature control-ed object front face of said temperature control jacket.

[0035] According to this invention, the liquid by which temperature control was carried out with the temperature control means is led to the liquid passage formed in the interior of a temperature control jacket of the liquid feeder style. Heat exchange is performed between the liquid led by the liquid feeder style and a temperature control-ed object through the heat-conduction member which surround a liquid passage periphery, and the temperature of this temperature control-ed object is kept constant to the predetermined temperature set up beforehand.

[0036] In a temperature control means to perform temperature control of a temperature control-ed object using this liquid by which temperature control was carried out The passage which pours this liquid and the liquid by which temperature control was carried out as a means to perform heat exchange between temperature control-ed objects, It has the heat-conduction member which transmits heat between the liquids and temperature control-ed objects by which temperature control was carried out. and the attachment and detachment whose a part or all of this passage, a heat-conduction member, or both had fixed flexibility -- by using an easy temperature control jacket To the temperature control-ed object which has a complicated concavo-convex front face and a delicate curvature configuration from the first, the projection optics with a cylinder or a cone configuration can stick a heat-conduction member on the side attachment wall enough, therefore can make contact thermal resistance small, and the efficient temperature control of it becomes possible. Furthermore, since flat-surface expansion is possible for this temperature control jacket, irrespective of whether it is carried in the body of equipment, it can perform easily the attachment and detachment from a temperature control-ed object, and becomes possible [performing a maintenance and repair of a temperature control-ed object comparatively simply].

[0037]

[Example] Drawing 1 is the perspective view showing the 1st example at the time of applying the heat exchange equipment for body temperature control concerning this invention to the projection lens of an aligner. This heat exchange equipment encloses the lens-barrel outer wall of the projection lens 3 in the temperature control jacket 13. The tube p as supple passage for this temperature control jacket 13 to pour the liquid f adjusted by predetermined temperature The bulking agent j which is a middle medium as a heat-conduction member for transmitting heat between Liquids f and the lens-barrel outer walls of the projection lens 3 which flow the inside of this tube p, and performing heat exchange It consists of resin sheets s which confine this bulking agent j and have the flexibility of an outline ******** sake in the configuration of the lens-barrel outer wall of the projection lens 3 in a

bulking agent j at least. When it removes from the projection lens 3, this temperature control jacket 13 can be developed to outline plate-like as it is expressed with drawing 2 (a). The detail of this temperature control jacket 13 is explained below using drawing 2 (b) which is drawing 2 (a) and its sectional view.

[0038] The bulking agent j is enclosed with the resin sheet s as a saccate sheet. Pure water, a fluorine system inactive liquid, silicone oil, a liquid metal, and a general cold insulator are used for a bulking agent j. A liquid metal, pure water, and silicone oil are excellent in thermal conductivity, and can expect the effectiveness which raises heat exchange effectiveness. Since it is excellent in electric insulation, the fluorine system inactive liquid uses and is suitable when there is the need of avoiding risk, such as short circuit accident, especially at the time of a liquid spill. Since heat capacity of a cold insulator is large, it can expect the accumulation effectiveness more than others and a liquid. What made multilayer structure a single or two or more sorts of resin ingredients, such as polyethylene and nylon, the barrier sheet of high intensity quantity airtightness which added the metal thin film to it are suitable for the resin sheet s for enclosing this bulking agent j.

[0039] Moreover, it is possible to be able to use thermal melting arrival for processing this resin sheet s into saccate, and to also secure the airtightness after processing enough. Interior is meanderingly carried out so that the tube p which has the flexibility for pouring the liquid f adjusted by predetermined temperature in the resin sheet s with which this bulking agent j was enclosed may sew this bulking agent j. Although Tube p is taken about in parallel with the longitudinal direction of the temperature control jacket 13 in drawing 2 (a), Tube p may be taken about a rectangular cross or aslant to a longitudinal direction at convenience [of mounting, such as bend radii of the temperature control jacket 13 whole,]. Ingredients, such as polyurethane resin which can secure the pressure-proofing for pouring a liquid in Tube p, and is supple, and polyethylene resin, a fluororesin, are used. The both ends of this tube p penetrate the resin sheet s, and those both ends serve as an entrance of Liquid f. By using thermal melting arrival, caulking, adhesion, etc., sufficient airtightness is secured, and a bulking agent j does not leak and come out of the part into which this tube p penetrates the resin sheet s, of course.

[0040] Moreover, this temperature control jacket 13 is making the space in the resin sheet s separate small if needed so that a configuration can be maintained that there is no constraint in the posture to be used, and especially thickness may become fixed. This is realized by joining mutually the resin sheet s of front flesh-side both sides which constitute the temperature control jacket 13 in many places. Moreover, temperature sensor d is attached in the front face of the side which touches the lens-barrel outer wall of the projection lens 3 of this temperature control jacket 13 if needed, and the temperature of the lens-barrel outer wall of the temperature control jacket 13 or the projection lens 3 can be detected with high precision.

[0041] The liquid f adjusted by predetermined temperature by the non-illustrated liquid temperature controller flows in in the temperature control jacket 13 from the inlet port of Tube p. The liquid f which flowed in arrives at the outlet of the temperature control jacket 13, performing the touching lens-barrel outer wall and heat exchange of the projection lens 3 through a bulking agent j and the resin sheet s. The liquid f which came out of the temperature control jacket 13 is again adjusted by predetermined temperature by the non-illustrated liquid temperature controller, and flows in in the temperature control jacket 13. Thus, when Liquid f circulates through a liquid temperature controller and the temperature control jacket 13, the projection lens 3 is maintained at predetermined temperature. Moreover, it is also possible to adjust the temperature of Liquid f by the liquid temperature controller so that it may become predetermined temperature about the temperature measured by temperature sensor d attached in the temperature control jacket 13 if needed.

[0042] Moreover, drawing 3 is the top view showing the 2nd example of this temperature control jacket. The points which made two the tube p which takes about the inside of a temperature control jacket to the 1st example differ. Tube p is taken about to 2 parallel, the tube of one of these is set to p1, and another side is set to p2. Tubes p1 and p2 can cancel the temperature nonuniformity of the temperature control jacket 13 resulting from the temperature gradient of the entrance of the liquid produced by heat exchange by pouring the liquids f1 and f2 by which temperature control was carried out to each so that it may become hard flow mutually. In drawing 3 , although 2 sets of entrances of a liquid are prepared to two tubes p1 and p2, the outlet of a tube p1 and the inlet port of

a tube p2 are connected, the entrance of Liquid f is made into a lot, and even if it pours Liquid f so that it may go and come back to two tubes, the same effectiveness is acquired. Same leading about may be carried out by one more tube, and tubes other than an entrance may be completely contained in the resin sheet s.

[0043] The top view and drawing 4 (b) which show the temperature control jacket which drawing 4 (a) requires for the 3rd example of this invention are the sectional view. Although the tube p for pouring the liquid f by which temperature control was carried out was contained in the resin sheet s in the 1st example, sheathing of the tube p is carried out to the resin sheet s in the temperature control jacket 13 concerning the 3rd example. The front rear face of the saccate resin sheet s is joined, two or more space is made, and the tube p for pouring the liquid f by which temperature control was carried out along the plane of composition on the line divided into two or more space after filling up with and closing the bulking agent j to two or more of the space is made to lay underground from the outside of the resin sheet s. Heat exchange of the liquid f by which temperature control was carried out is carried out to a bulking agent j through the wall surface of Tube p, and the resin sheet s. Furthermore, when a bulking agent j performs the lens-barrel outer wall and heat exchange of the projection lens 3 which touch this temperature control jacket 13 through the resin sheet s, the projection lens 3 is maintained at predetermined temperature.

[0044] Although the space which encloses a bulking agent j is divided into band-like [two or more] in drawing 4 (a), it is also possible to divide also in the direction which intersects perpendicularly with it further, to increase the number of partitions of space, and to stabilize the configuration of the temperature control jacket 13 more. Moreover, if sheathing is carried out to the shape of a grid by 1 thru/or two or more tubes p also about the tube p which carries out sheathing, it is expectable to raise the amount of heat exchange further.

[0045] Moreover, it is also possible to paste up the tube p which carries out sheathing, and the resin sheet s. While being able to prevent omission of Tube p by adhesion, contact thermal resistance can be made small, and heat exchange effectiveness can be raised. Moreover, if it is only omission prevention of Tube p, it is also possible to stick on the resin sheet s of the insertion side of Tube p the film made with the resin metallurgy group thin film over the whole. Thus, by carrying out sheathing of the tube p, saccate processing of the resin sheet s and the leading-about activity of Tube p become easy, and it can count upon reduction of processing cost.

[0046] Furthermore, two resin sheets s with which the bulking agent j was enclosed are prepared like drawing 4 (c), Tube p is taken about between this resin sheet s of two sheets, and reduction of processing cost with the same said of joining so that these may be mutually stuck by adhesion can be expected.

[0047] Although the outside surface was covered with the resin sheet s in the temperature control jacket concerning these [1st] - the 3rd example, it is possible to equalize the temperature distribution of the temperature control jacket 13 further by sticking on the outside surface the sheet which contains graphite with the very high thermal conductivity of the direction of a field in an ingredient if needed. Moreover, it is possible to raise thermal efficiency by sticking a heat insulator on the field of the opposite side of the field of the temperature control jacket 13 which touches the lens-barrel outer wall of the projection lens 3 depending on the environmental temperature to be used.

[0048] The 1st - the 3rd example have described above for the temperature control of the lens-barrel outer wall of the shape of a cylindrical shape which constitutes the projection lens 3. As for the lens-barrel of the actual projection lens 3, not only the shape of a cylindrical shape but the cone configuration section may be contained. An example of the temperature control jacket corresponding to a cone configuration is shown in drawing 5 as the 4th example. A cone configuration is imitated at the time of wearing by making the appearance of the temperature control jacket 13 into the shape of a sector which developed the cone configuration, and effective temperature control becomes possible.

[0049] Moreover, drawing 6 is the perspective view showing the 5th example at the time of applying this invention to the projection lens 3 of an aligner. The temperature control jacket 13 into which it processed band-like is spirally twisted around the lens-barrel outer wall of the projection lens 3. In this case, a lens-barrel can respond, not only the shape of a cylindrical shape but when there are a

cone configuration and complicated irregularity. Drawing 7 and drawing 8 are the top views showing the detail of the temperature control jacket into which it processed band-like [this]. Although fundamental structure is the same as what is shown in drawing 2 (a) and drawing 4 (b), it becomes easy to carry out processing by having considered as band-like, and can count upon reduction of processing cost further.

[0050] Moreover, the perspective view and drawing 10 (a) which show the 6th example when drawing 9 applies the temperature control jacket concerning this invention to the projection lens 3 of an aligner are [the sectional view and drawing 10 (c) of the top view of a temperature control jacket and drawing 10 (b)] the rear view of drawing 10 (a). This example constitutes two or more bulking agents j which constitute the temperature control jacket 13, and blocks BL which prepared the almost same curvature as the curvature of the lens-barrel outer wall of the projection lens 3 in the whole surface at least instead of the resin sheet s which encloses it to said 1st [the] - the 5th example, and the points which used this block BL as the main heat-conduction member differ. When it removes from the projection lens 3, this temperature control jacket 13 can be developed to outline plate-like, without removing the tube p with which the liquid f by which temperature control was carried out flows as it is expressed with drawing 10 (a). The detail of this temperature control jacket 13 is explained below using drawing 10 (a), drawing 10 (b), and drawing 10 (c).

[0051] It has the almost same curvature as the curvature of the lens-barrel outer wall of the projection lens 3 of Block BL which the whole surface at least touches. In order to transmit heat to Block BL between Liquid f and the lens-barrel outer wall of the projection lens 3, an ingredient with high thermal conductivity and specific heat, for example, aluminum, copper, or those alloys are suitable. Moreover, the hole has opened two or more in this block BL as passage which pours the liquid f by which temperature control was carried out. Although it may be cylindrical, by making surface roughness coarse or processing into intentionally the smooth configuration which has the irregularity of a screw etc. over an overall length, this hole can enlarge a touch area with the liquid f by which temperature control was carried out, and is possible also for raising heat exchange effectiveness to the maximum extent by making into a turbulent flow the condition of the liquid f which flows this hole further.

[0052] Furthermore, two or more holes made in these blocks BL of two or more are connected by the tube p which is mutually supple. A non-illustrated joint may be used for connection with the tube p during this block BL. Moreover, although the connected surface of this tube p is established in the field which carries out an abbreviation rectangular cross to a field with curvature in drawing 10 (a) - (c), Tube p may be connected with the adjoining block BL in the shape of U character by making into a connected surface the field which counters this curvature side, for example. Moreover, the path of two or more holes made in Block BL may be mostly processed into this dimension with the outer diameter of Tube p, and this tube p may be ******(ed) so that the hole of this block BL may be contacted directly. By carrying out direct contact pressure insertion in a hole, it can perform simply tuning spacing during each block BL finely a splice not only becomes unnecessary, but, and there is an advantage which can reduce assembly cost.

[0053] Moreover, after insertion, contact thermal resistance can be lessened as much as possible by pasting up Tube p and Block BL mutually, and heat exchange effectiveness can be gathered. Moreover, in this example, it is made to stick so that each block BL may be connected with the connection sheet g apart from Tube p, and the distance during each block BL is always kept constant with this connection sheet g. In case the lens-barrel of the projection lens 3 is equipped with this temperature control jacket 13, it works so that this connection sheet g may be wound around the lens-barrel outer wall of the projection lens 3, and it becomes possible to stick the temperature control jacket 13 on a temperature control-ed body simply and certainly by concluding the both ends of the connection sheet g possible [discharge] in a non-illustrated band etc.

[0054] Moreover, some die length of the tube p made to connect to spacing during each block BL by constituting this connection sheet g can be set up for a long time. The dimension error of the die length of Tube p by it Since [a certain] extent permission can be carried out, At the time of wearing on a temperature control-ed body, the assembly of the temperature control jacket 13 becomes easy, and it can make [the excessive force cannot be applied, and] it Tube p, and there is an advantage which can prevent fracture of Tube p and omission of the tube p from a non-illustrated splice.

Moreover, if the magnetic substance is used as one of the components of this connection sheet g, it is also possible to be able to keep comparatively equal the contact pressure between the lens-barrels of Block BL and the projection lens 3, and to control the whole lens-barrel of the projection lens 3 by this adsorption power to comparatively uniform temperature distribution.

[0055] Moreover, although contact thermal resistance will become large and heat exchange effectiveness will fall so that the surface roughness of both the contact surfaces which contacts mutually [the lens-barrel outer wall of Block BL and the projection lens 3] becomes coarse, by using an ingredient with comparatively low surface hardness for this connection sheet g, Block BL and the adhesion between the lens-barrel outer walls of the projection lens 3 can be raised, and improvement in heat exchange effectiveness can be expected. Moreover, it becomes possible by using the graphite sheet with the heat conductivity of the direction of a flat surface high [one] of the component of this connection sheet g to be able to expect heat exchange with the lens-barrel of the projection lens 3 also in the connection sheet g part which Block BL does not touch, to raise the heat exchange effectiveness of the temperature control jacket 13, and to carry out temperature control of the lens-barrel of the projection lens 3 to more uniform temperature distribution.

[0056] Next, the sectional view and drawing 11 (c) of the top view showing the 7th example of the temperature control jacket which drawing 11 (a) requires for this invention, and 11 (b) are the rear view of drawing 11 (a). These 7th examples differ at the point which transposed the block BL as a main heat-conduction member used in said 6th example to Plate PL. That is, it has two or more plates PL with the almost same curvature as the lens-barrel outer wall of the projection lens 3, and two or more piping used as the passage of the liquid f by which temperature control was carried out to the outer wall of each of this plate PL is prepared. Like said block BL, aluminum, copper, or those alloys are suitable for the quality of the material of this plate PL, and it can obtain curvature equivalent to the lens-barrel outer wall of the projection lens 3 comparatively easily by bending. Moreover, it is possible to form the passage of the liquid f with touch area sufficient by welding a metallic conduit to them by which temperature control was carried out. About the configuration of the tube p which connects two or more plates and serves as passage of the liquid f by which temperature control was carried out, and other configurations, such as the connection sheet g on which each plate PL is connected and stuck further, it is possible to make it be the same as that of said 6th example.

[0057] Moreover, the plate PL as this main heat-conduction member If you may be a looping capillary heat pipe or a graphite sheet tabular [using the heat transport by self-excitation of a vapor-liquid bilayer] and a looping capillary heat pipe is applied While raising further the heat exchange effectiveness between the lens-barrels of the liquid f by which became possible [making the temperature distribution of Plate PL into homogeneity further], therefore temperature control was carried out, and the projection lens 3, it becomes possible to maintain more the temperature distribution of the lens-barrel of the projection lens 3 at homogeneity. Incidentally it has been the description for the looping capillary heat pipe of Plate PL to have the high heat transport capacity of the one direction within the field of Plate PL, and for it not to be comparatively based on an installation posture, but to demonstrate capacity. Therefore, this direction of heat transport is taken to the longitudinal direction of Plate PL, and if piping used as the passage of the liquid f by which temperature control was carried out in the direction of a shorter side is prepared, it will become possible to fully demonstrate the capacity of this looping capillary heat pipe more.

[0058] Moreover, the lens-barrel of the actual projection lens 3 may serve as an irregular configuration which piled up the shape of a cylindrical shape not only with when it is the configuration which combined the shape of a cylindrical shape which has a uniform outer diameter covering an overall length, and it and a cone configuration but various outer diameters. In such a case, the die length of each temperature control jacket 13, spacing during two or more blocks BL, and the curvature of the curved surface further established in Block BL can respond by considering as the dimension doubled with the lens-barrel outer diameter of the corresponding projection lens 3, respectively, using the band-like temperature control jacket 13 which constituted two or more blocks BL which prepared the almost same curvature as the curvature of the lens-barrel outer wall of the projection lens 3 in the whole surface at least as shown in drawing 12 in the single tier two or more. in this case, the entrance of the liquid f by which was made to connect each temperature control

jacket 13 with a serial by Tube p, and temperature control was carried out -- the whole -- one -- you may prepare -- moreover, each temperature control jacket 13 -- it may be alike, respectively and you may prepare. Moreover, the approach using two or more of these band-like temperature control jackets 13 of not only the block BL but the case where the aforementioned bulking agent j and the resin sheet s which encloses it are used as a main heat-conduction member and the temperature control jacket 13 using Plate PL being applicable is natural.

[0059] Although the object which equips with the temperature control jacket 13 so far has been extracted and stated to the projection lens 3 of an aligner, it uses and is suitable not only for a projection lens but the temperature control of various optical system, such as cooling of the temperature control of the stanchion which supports the interference system for length measurement, or the laser light source for interferometers, and an off axis microscope. Drawing 13 is the top view showing one example of the temperature control jacket 13 with which a temperature control object is applied like the laser light source for interferometers in the case of an outline rectangular parallelepiped. This temperature control jacket 13 makes the sheet s of a convex typeface move in a zigzag direction, arranges Tube p, and has a form which developed 4th page other than a laser light source base and an exit hole.

[0060] (Example of an aligner) The example of the scanning aligner carrying the projection lens equipped with the heat exchange equipment of the example mentioned above next is explained using drawing 19 . The lens-barrel surface plate 96 is supported through the damper 98 from the floor or the base 91. Moreover, the lens-barrel surface plate 96 is supporting the projection optics 97 located between a reticle stage 95 and the wafer stage 93 while supporting the reticle stage surface plate 94.

[0061] The wafer stage 93 is supported on the stage surface plate 92 supported from the floor or the base 91, and positions by laying a wafer. Moreover, the reticle stage 95 carries the reticle in which it was supported on the reticle stage surface plate 94 supported by the lens-barrel surface plate 96, and the circuit pattern was formed and is movable. The exposure light which exposes the reticle carried on the reticle stage 95 to the wafer on the wafer stage 93 is generated from the illumination-light study system 99.

[0062] In addition, the wafer stage 93 is scanned synchronizing with a reticle stage 95. During the scan of a reticle stage 95 and the wafer stage 93, by the interferometer, both location is detected continuously, respectively and is fed back to the mechanical component of a reticle stage 95 and the wafer stage 93, respectively. While synchronizing both scan starting position correctly, the scan speed of a constant-speed scan field is controllable by this with high degree of accuracy. While both are scanning to projection optics 97, a reticle pattern is exposed on a wafer and a circuit pattern is imprinted.

[0063] In this example, since the projection lens equipped with the heat exchange equipment of the above-mentioned example is used, it becomes possible to carry out temperature control of the front faces, such as projection optics, with high precision, and a high speed and highly precise exposure are attained.

[0064] (Example of a semi-conductor production system) Next, the example of the production system of the semiconductor devices (semiconductor chips, such as IC and LSI, a liquid crystal panel, CCD, the thin film magnetic head, micro machine, etc.) using the aligner equipped with the heat exchange equipment concerning this invention is explained. This performs maintenance service, such as trouble correspondence of the manufacturing installation installed in the semi-conductor plant, and a periodic maintenance or software offer, using the computer network besides a plant.

[0065] Drawing 14 cuts down and expresses a whole system from a certain include angle. 101 are the place of business of the vendor (equipment supply manufacturer) which offers the manufacturing installation of a semiconductor device among drawing. As an example of a manufacturing installation, the semiconductor fabrication machines and equipment for [various] processes (assembly equipment, test equipment, etc.) used by the semi-conductor plant, for example, the devices for last processes (lithography equipments, such as an aligner, a photo lithography processor, and an etching system, a thermal treatment equipment, membrane formation equipment, flattening equipment, etc.) and the devices for back processes, are assumed. In a place of business 101, it has the host managerial system 108 which offers the maintenance database of a manufacturing installation, two or more actuation terminal computers 110, and Local Area Network (LAN) 109

which connects these and builds intranet etc. The host managerial system 108 is equipped with the security function to restrict the gateway for connecting LAN109 to the Internet 105 which is the external network of a place of business, and access from the outside.

[0066] On the other hand, 102-104 are the plants of the semi-conductor manufacture manufacturer as a user of a manufacturing installation. Plants 102-104 may be the works belonging to a mutually different manufacturer, and may be the works (for example, works for last processes, works for back processes, etc.) belonging to the same manufacturer. In each works 102-104, the host managerial system 107 is formed as two or more manufacturing installations 106, Local Area Network (LAN) 111 which connects them and builds intranet etc., and supervisory equipment which supervises the operation situation of each manufacturing installation 106, respectively. The host managerial system 107 formed in each works 102-104 is equipped with the gateway for connecting LAN111 in each works to the Internet 105 which is the external network of works. Access becomes possible from LAN111 of each works through the Internet 105 at the host managerial system 108 by the side of a vendor 101 by this, and access is permitted only at the user restricted by the security function of the host managerial system 108. The status information (for example, symptom of the manufacturing installation which the trouble generated) which shows the operation situation of each manufacturing installation 106 is specifically notified to a vendor side from a works side through the Internet 105, and also maintenance information, such as a response indication (for example, information, software and data for management which direct the solution for a trouble) corresponding to the notice, and the newest software, help information, is receivable from a vendor side. The communications protocol (TCP/IP) currently generally used by the Internet is used for the data communication between each works 102-104 and a vendor 101, and the data communication in LAN111 in each works. In addition, the high dedicated line networks (ISDN etc.) of security can also be used instead of using the Internet as an external network outside works, without the ability performing access from a third person. Moreover, what [not only] a vendor offers but a user builds a database, a host managerial system places it on an external network, and you may make it permit access to this database from two or more works of a user.

[0067] Now, drawing 15 is the conceptual diagram which cut down and expressed this whole operation gestalt system from the include angle different from drawing 14 . In the previous example, each was what connects two or more user works equipped with the manufacturing installation, and the managerial system of the vendor of this manufacturing installation in an external network, and carries out data communication of the production control of each works, or the information on at least one set of a manufacturing installation through this external network. On the other hand, this example connects works equipped with the manufacturing installation of two or more vendors, and the managerial system of each vendor of two or more of these manufacturing installations in the external network outside works, and carries out data communication of the maintenance information on each manufacturing installation. Among drawing, 201 are a manufacturing installation user's (semiconductor device manufacture manufacturer) plant, and the aligner 202, the photo lithography processor 203, and the membrane formation processor 204 are introduced into the production line of works as an example the manufacturing installation which performs various processes, and here. In addition, in drawing 15 , although only one plant 201 is drawn, two or more works are similarly connected by network in practice. It connects by LAN206, each equipment in works constitutes intranet, and operation management of a production line is carried out with the host managerial system 205.

[0068] On the other hand, each place of business of vendors (equipment supply manufacturer), such as the aligner manufacturer 210, the photo lithography processor manufacturer 220, and the membrane formation equipment manufacturer 230, is equipped with the host managerial system 211,221,231 for performing control maintenance of the device supplied, respectively, and these equip it with the gateway of a maintenance database and an external network, as mentioned above. The host managerial system 205 which manages each equipment in a user's plant, and the managerial system 211,221,231 of the vendor of each equipment are connected by the Internet or the dedicated line network which is the external network 200. In this system, although operation of a production line will stop if a trouble occurs in one of a series of manufacture devices of a production line, a prompt action is possible by receiving the control maintenance through the Internet 200 from the

vendor of the device by which the trouble occurred, and a pause of a production line can be suppressed to the minimum.

[0069] Each manufacturing installation installed in the semi-conductor plant is equipped with the computer which performs a display, a network interface, software for network access stored in storage, and software for equipment actuation, respectively. As a store, they are an internal memory, a hard disk or a network file server, etc. The above-mentioned software for network access offers the user interface of a screen as shows an example to drawing 16 on a display, including dedication or a general-purpose web browser. The operator who manages a manufacturing installation at each works inputs the information on the model 401 of manufacturing installation, a serial number 402, the subject name 403 of a trouble, the generating day 404, an urgency 405, a symptom 406, the coping-with method 407, and progress 408 grade into the input item on a screen, referring to a screen. It is transmitted to a maintenance database through the Internet, and the suitable maintenance information on the result is answered from a maintenance database, and the inputted information is shown on a display. Moreover, the user interface which a web browser offers can pull out further the actuation guide (help information) with which the hyperlink functions 410-412 are realized, and the software of the latest version used for a manufacturing installation from the software library which a vendor offers is pulled out, or reference of the operator of works is presented like illustration. [that an operator accesses the still more detailed information on each item] Here, the information about this invention which gave [above-mentioned] explanation is also included in the maintenance information which a maintenance database offers, and said software library also offers the newest software for realizing this invention.

[0070] Next, the manufacture process of a semiconductor device of having used the production system which gave [above-mentioned] explanation is explained. Drawing 17 shows the flow of the overall manufacture process of a semiconductor device. The circuit design of a semiconductor device is performed at step 1 (circuit design). The mask in which the designed circuit pattern was formed is manufactured at step 2 (mask manufacture). On the other hand, at step 3 (wafer manufacture), a wafer is manufactured using ingredients, such as silicon. Step 4 (wafer process) is called a last process, and forms an actual circuit on a wafer with a lithography technique using the mask and wafer which carried out [above-mentioned] preparation. The following step 5 (assembly) is called a back process, is a process semiconductor-chip-ized using the wafer produced by step 4, and includes assembly processes, such as an assembly process (dicing, bonding) and a packaging process (chip enclosure). At step 6 (inspection), the check test of the semiconductor device produced at step 5 of operation, an endurance test, etc. are inspected. A semiconductor device is completed through such a process and this is shipped (step 7). A last process and a back process are performed at another works of dedication, respectively, and maintenance is made by the control maintenance system which gave [above-mentioned] explanation for every works of these. Moreover, also between last process works and back process works, data communication of the information for production control or equipment maintenance is carried out through the Internet or a dedicated line network.

[0071] Drawing 18 shows the detailed flow of the above-mentioned wafer process. The front face of a wafer is oxidized at step 11 (oxidation). At step 12 (CVD), an insulator layer is formed on a wafer front face. At step 13 (electrode formation), an electrode is formed by vacuum evaporationo on a wafer. Ion is driven into a wafer at step 14 (ion implantation). A sensitization agent is applied to a wafer at step 15 (resist processing). At step 16 (exposure), printing exposure of the circuit pattern of a mask is carried out at a wafer with the aligner which gave [above-mentioned] explanation. The exposed wafer is developed at step 17 (development). At step 18 (etching), parts other than the developed resist image are shaved off. The resist which etching could be managed with step 19 (resist exfoliation), and became unnecessary is removed. By carrying out by repeating these steps, a circuit pattern is formed on a wafer multiplex. Even if a trouble occurs, quick restoration can be possible for it, and the manufacture device used at each process can raise the productivity of a semiconductor device compared with the former while it prevents a trouble, since maintenance is made by the control maintenance system which gave [above-mentioned] explanation.

[0072]

[Effect of the Invention] In the heat exchange equipment for body temperature control which performs temperature control of a temperature control-ed object as mentioned above using the liquid

by which temperature control was carried out according to this invention The passage which pours this liquid and the liquid by which temperature control was carried out as a means to perform heat exchange between temperature control-ed objects, By having the heat-conduction member which transmits heat between the liquids and temperature control-ed objects by which temperature control was carried out, and using the removable temperature control jacket in which the passage of a parenthesis, and a part or all of a heat-conduction member had fixed flexibility As opposed to the temperature control-ed object in which the projection optics with a cylinder or a cone configuration has a complicated concavo-convex front face and a delicate curvature configuration from the first It became possible to stick a heat-conduction member on the side attachment wall enough, it became possible to obtain the good heat exchange engine performance, and it became possible to satisfy the predetermined temperature control engine performance. By applying this to temperature control, such as a heat source concerning the temperature control, alignment system, and interferometer length measurement system of projection optics of a projection aligner, it became possible to acquire the highly precise image formation engine performance and superposition precision. Moreover, this temperature control jacket has the advantage which can perform easily the attachment and detachment from a temperature control-ed object since flat-surface expansion is possible, and it became possible to shorten sharply the time amount concerning repair and a maintenance of a temperature control-ed object.

[0073] Furthermore, since precise temperature management of the projection optics in the inside of a production process is attained and it becomes possible to make almost the same the temperature condition of the projection lens after including in the temperature condition and the body of a projection aligner of a projection lens simple substance in a production process, It became possible to maintain also on a body the projection lens engine performance adjusted and driven in into the production process, and the yield of projection lens manufacture improved and manufacture of the projection aligner which is stabilized further and has the high image engine performance was attained.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective view showing the 1st example at the time of equipping the projection lens of an aligner with the temperature control jacket of the heat exchange equipment for body temperature control concerning this invention.
[Drawing 2] The top view showing the temperature control jacket which (a) requires for the 1st example of this invention, and (b) are the sectional view.
[Drawing 3] It is the top view showing the temperature control jacket of the heat exchange equipment for body temperature control concerning the 2nd example of this invention.
[Drawing 4] The top view showing the temperature control jacket of the heat exchange equipment for body temperature control which (a) requires for the 3rd example of this invention, and (b) are the sectional view.
[Drawing 5] It is the top view showing the temperature control jacket of the heat exchange equipment for body temperature control concerning the 4th example of this invention.
[Drawing 6] It is the perspective view showing the 5th example at the time of equipping the projection lens of an aligner with the temperature control jacket of the heat exchange equipment for body temperature control concerning this invention.
[Drawing 7] It is the top view showing the 1st modification of the temperature control jacket concerning the 5th example of this invention.
[Drawing 8] It is the top view showing the 2nd modification of the temperature control jacket concerning the 5th example of this invention.
[Drawing 9] It is the perspective view showing the 6th example at the time of equipping the projection lens of an aligner with the temperature control jacket of the heat exchange equipment for body temperature control concerning this invention.
[Drawing 10] The sectional view and (c of the top view showing the temperature control jacket which (a) requires for the 6th example of this invention, and (b)) are the rear view of (a).
[Drawing 11] The sectional view and (c of the top view showing the temperature control jacket of the heat exchange equipment for body temperature control which (a) requires for the 7th example of this invention, and (b)) are the rear view of (a).
[Drawing 12] The top view showing the temperature control jacket of the heat exchange equipment for body temperature control which (a) requires for the 8th example of this invention, and (b) are the rear view.
[Drawing 13] It is the top view showing the temperature control jacket of the heat exchange equipment for body temperature control concerning the 9th example of this invention.
[Drawing 14] It is the conceptual diagram which looked at the production system of the semiconductor device using the aligner which used the heat exchange equipment for body temperature control concerning this invention from a certain include angle.
[Drawing 15] It is the conceptual diagram which looked at the production system of the semiconductor device using the aligner which used the heat exchange equipment equipment for body temperature control concerning this invention from another include angle.
[Drawing 16] It is the example of a user interface.
[Drawing 17] It is drawing explaining the flow of the manufacture process of a device.
[Drawing 18] It is drawing explaining a wafer process.

[Drawing 19] It is the schematic diagram showing the example of the aligner using the heat exchange equipment concerning this invention.
[Drawing 20] It is the schematic diagram of the conventional semi-conductor aligner.
[Description of Notations]
An illumination-light study system, 2:reticle, 3:projection lens, 4:wafer, 5 : 1: A wafer stage, 6: An off axis microscope, 7:criteria mirror, 8:laser interferometer, 9 : A laser interferometer mounting post, 10: The light source for laser interferometers, 11:air-conditioning air diffuser, 12 : The body structure of an aligner, 13 -- : -- temperature control -- a jacket -- f -- f -- one -- f -- two -- f -- ' -- f -- one -- ' -- f -- two -- ' -- : -- a liquid (heat carrier) -- j : A bulking agent, p and p1, a p2:tube, s:resin sheet, BL:block, PL : A plate, 91:base, 92:stage surface plate, 93:wafer stage, 94: A reticle stage surface plate, 95:reticle stage, 96 : A lens-barrel surface plate, 97 : Projection optics, 98:damper, 99:illumination-light study system, the place of business of a 101:vendor, 102,103,104 : A plant, the 105:Internet, a 106:manufacturing installation, 107 : The host managerial system of works, the host managerial system by the side of a 108:vendor, 109: The Local Area Network (LAN) by the side of a vendor, 110 : An actuation terminal computer, 111 : The Local Area Network (LAN) of works, a 200:external network, 201: A manufacturing installation user's plant, a 202:aligner, 203 : A photo lithography processor, 204: A membrane formation processor, the host managerial system of 205:works, 206 : The Local Area Network of works (LAN), 210: An aligner manufacturer, 211 : The host managerial system of an aligner manufacturer's place of business, 220: A photo lithography processor manufacturer, 221 : The host managerial system of a photo lithography processor manufacturer's place of business, 230: A membrane formation equipment manufacturer, 231 : The host managerial system of a membrane formation equipment manufacturer's place of business, 401: -- the model of manufacturing installation, a 402:serial number, the subject name of a 403:trouble, a 404:generating day, and 405: -- an urgency, a 406:symptom, the 407:coping-with method, 408:progress, and a 410,411,412:hyperlink function.

[Translation done.]

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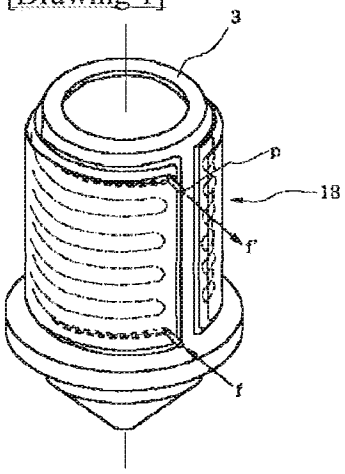
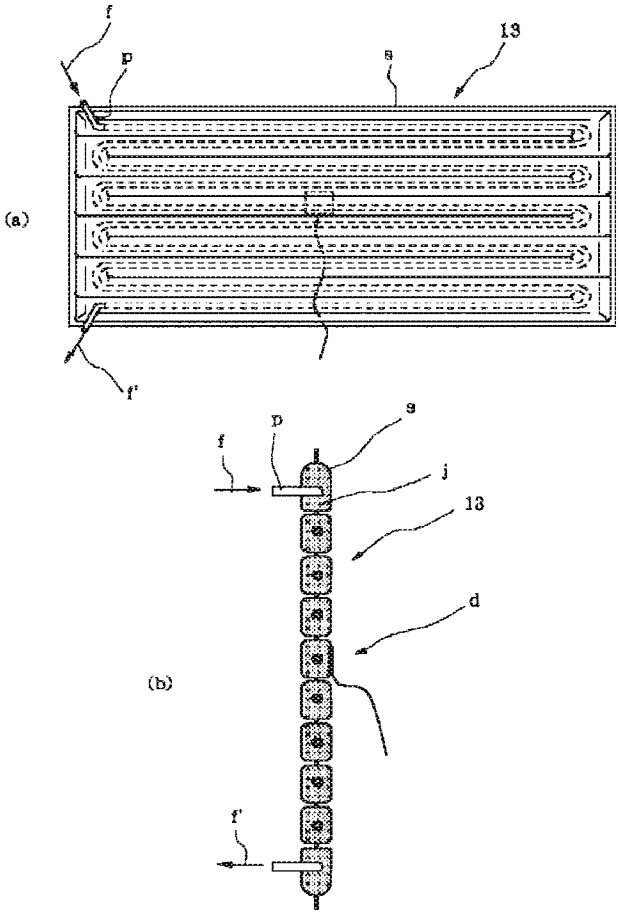
DRAWINGS

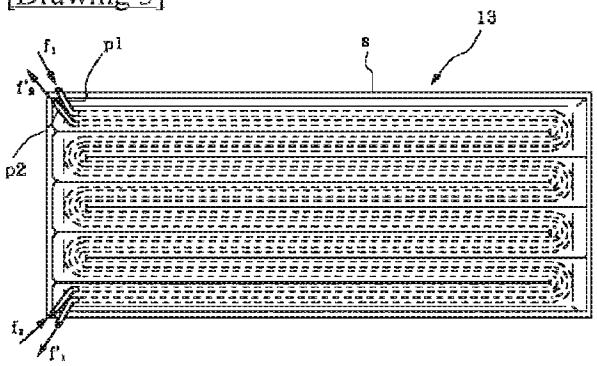
[Drawing 1]



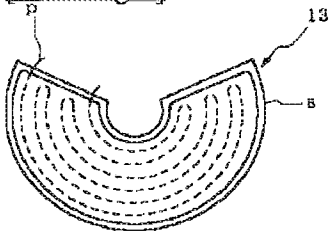
[Drawing 2]



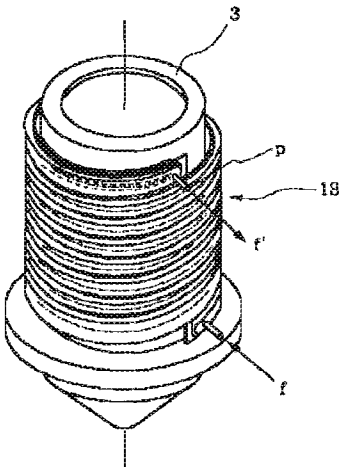
[Drawing 3]



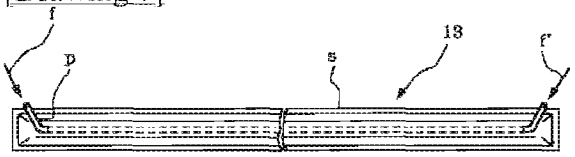
[Drawing 5]



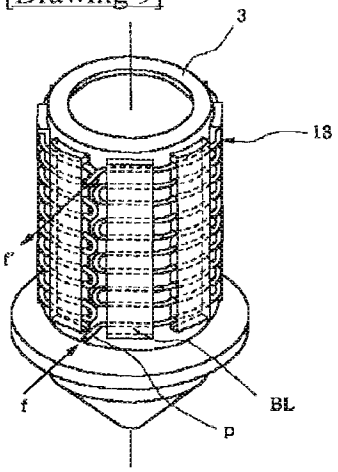
[Drawing 6]



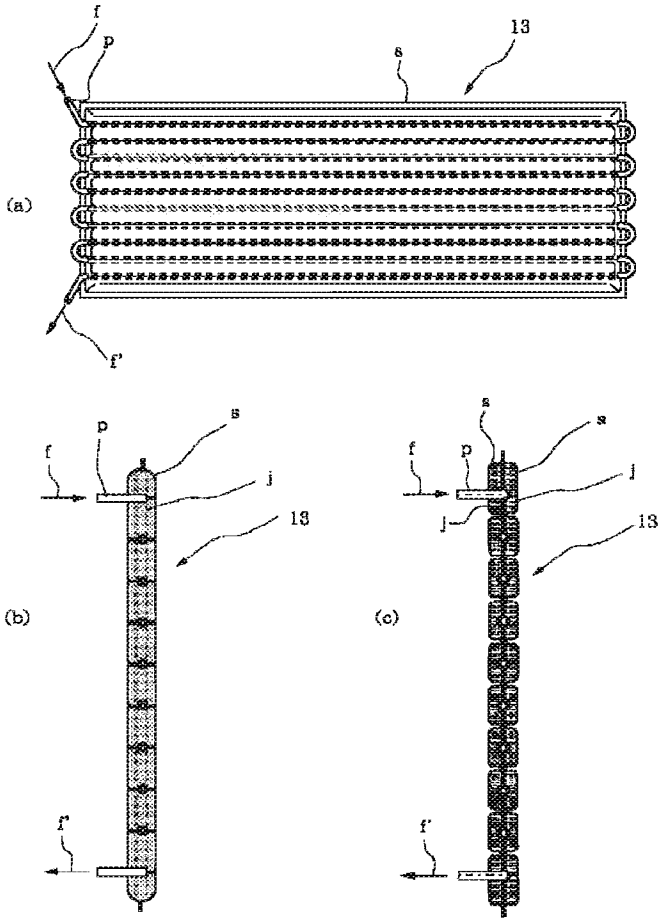
[Drawing 7]



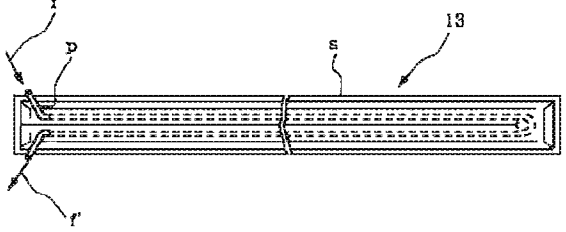
[Drawing 9]



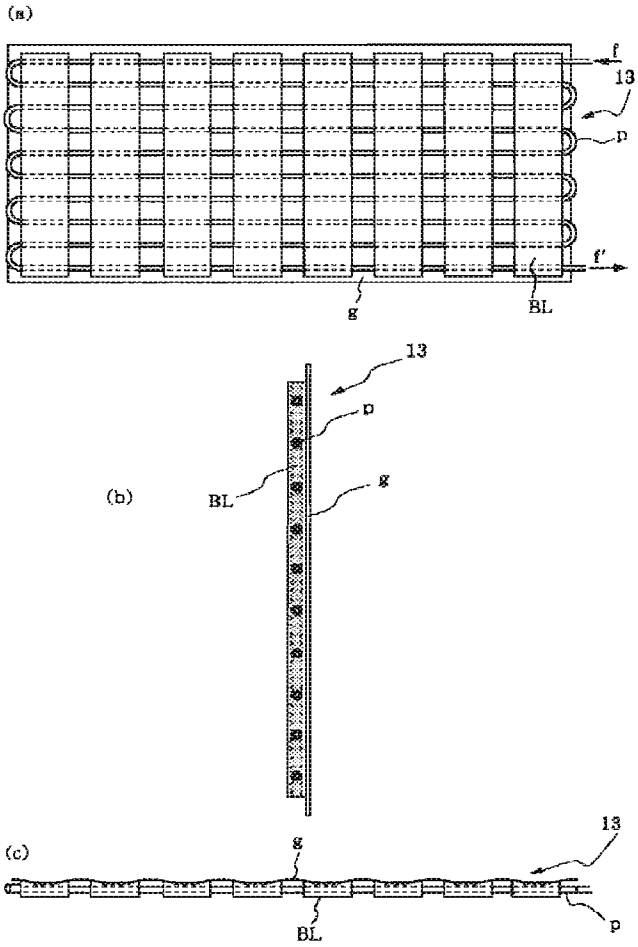
[Drawing 4]



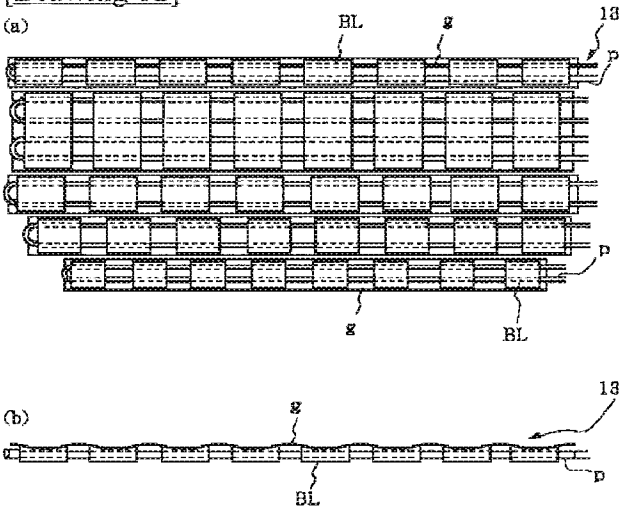
[Drawing 8]



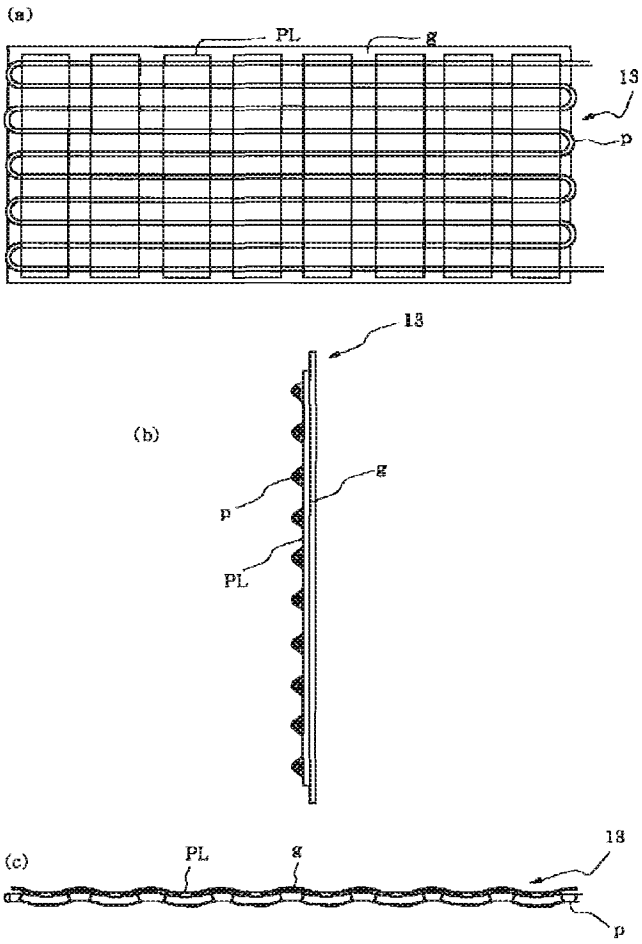
[Drawing 10]



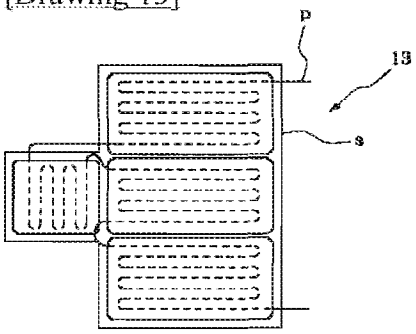
[Drawing 12]



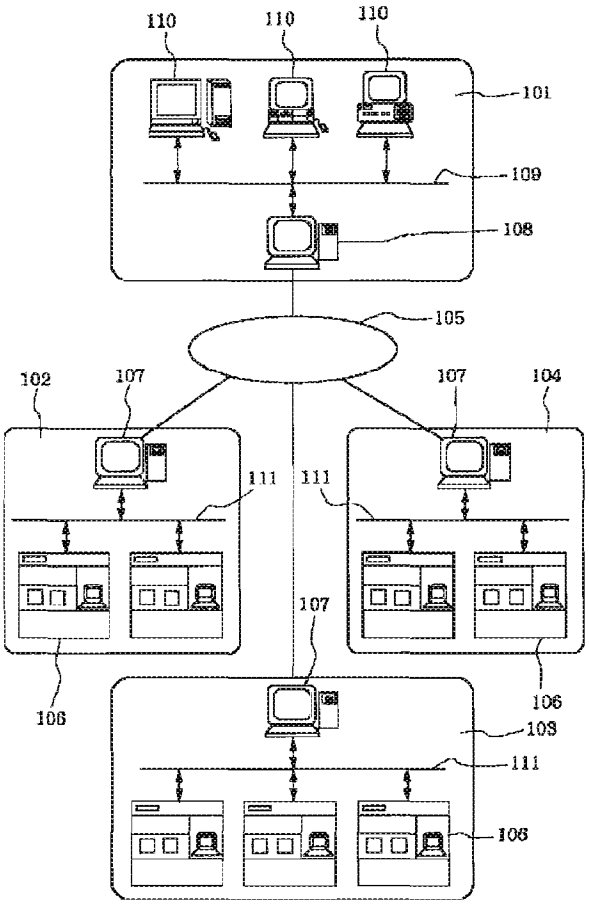
[Drawing 11]



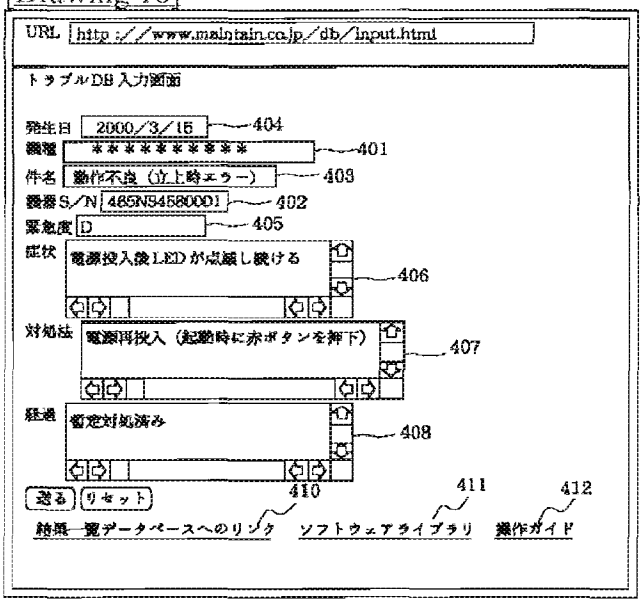
[Drawing 13]



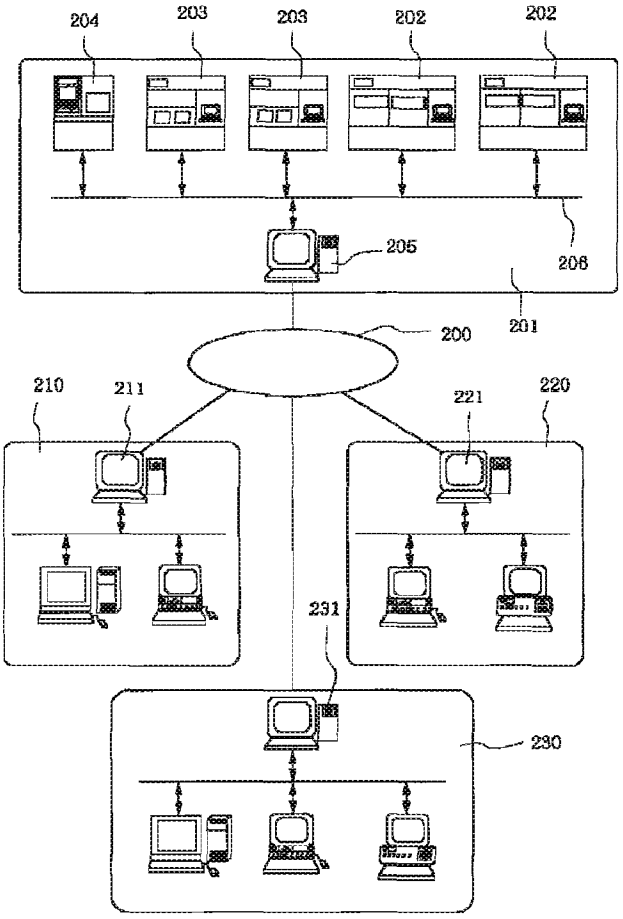
[Drawing 14]



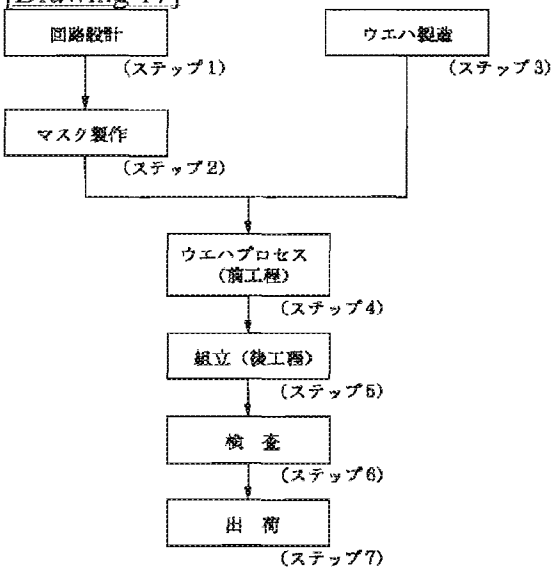
[Drawing 16]



[Drawing 15]

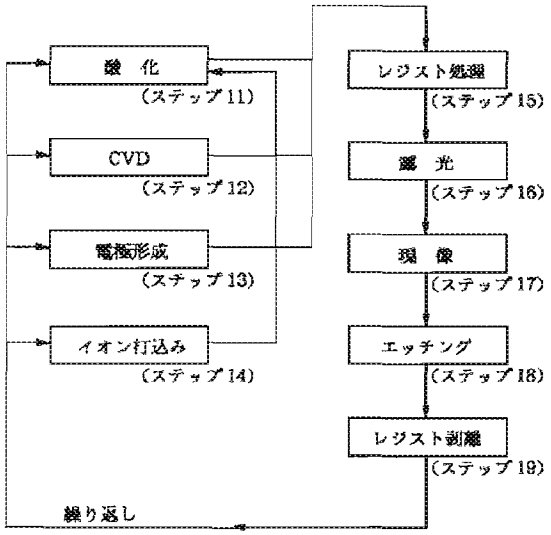


[Drawing 17]



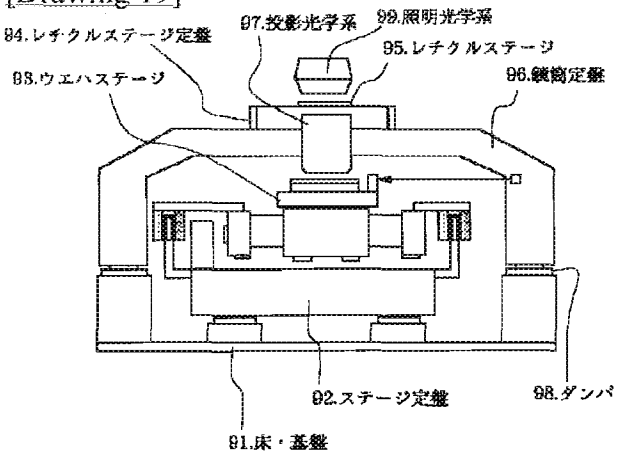
半導体デバイス製造フロー

[Drawing 18]

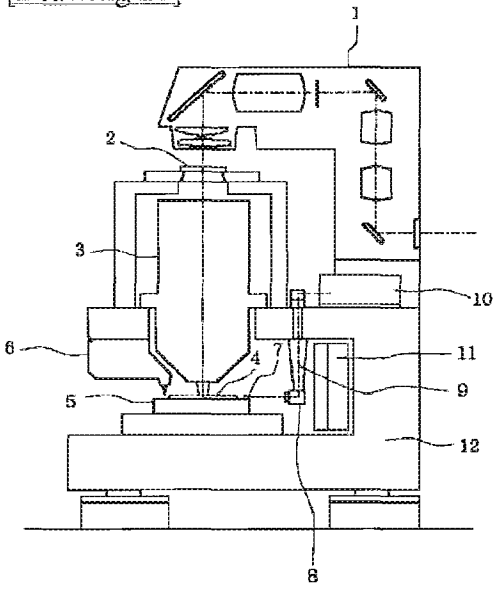


ウエハプロセス

[Drawing 19]



[Drawing 20]



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CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law
[Section partition] The 3rd partition of the 5th section
[Publication date] August 9, Heisei 19 (2007. 8.9)

[Publication No.] JP,2002-5586,A (P2002-5586A)
[Date of Publication] January 9, Heisei 14 (2002. 1.9)
[Application number] Application for patent 2000-189303 (P2000-189303)
[International Patent Classification]

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G02B 7/02 (2006.01)
G03F 7/20 (2006.01)
H01L 21/027 (2006.01)
[FI]

F28D 21/00 Z
G02B 7/02 F
G03F 7/20 521
H01L 21/30 502 H

[Procedure revision]
[Filing Date] June 21, Heisei 19 (2007. 6.21)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] The name of invention
[Method of Amendment] Modification
[The contents of amendment]
[Title of the Invention] Equipment possessing the semiconductor-fabrication-machines-and-equipment optical system, the optical system for test equipment, or the optical system for measuring devices by which temperature control is carried out with the heat exchange equipment for body temperature control, and this heat exchange equipment
[Procedure amendment 2]
[Document to be Amended] Specification
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[The contents of amendment]
[Claim(s)]
[Claim 1] The heat-exchange equipment for body temperature control characterized by to have a liquid feeder style for having prepared the temperature-control jacket which has the flexibility with which it can equip removable in said temperature-control-ed object in a part of one [at least] heat-conduction member [at least] which transmits heat between the liquids and the temperature-control-ed objects by which this temperature control was carried out to the passage which pours the liquid by which temperature control was carried out, and supplying said liquid by which temperature control

was carried out.
[Claim 2] Heat exchange equipment for body temperature control according to claim 1 characterized by the ability of said temperature control jacket removed from said temperature control-ed object to develop in the shape of an approximate plane.
[Claim 3] Heat exchange equipment for body temperature control according to claim 2 characterized by arranging said temperature control jacket spirally in contact with said temperature control-ed object front face.
[Claim 4] Heat exchange equipment for body temperature control according to claim 2 or 3 characterized by arranging a heat-conduction promotion member in the field which counters said temperature control-ed object front face of said temperature control jacket.
[Claim 5] Heat exchange equipment for body temperature control according to claim 4 characterized by said heat-conduction promotion member becoming by graphite.
[Claim 6] Heat exchange equipment for body temperature control according to claim 2 characterized by arranging a magnetic member in the field of said temperature control jacket which counters said temperature control-ed object front face.
[Claim 7] Heat exchange equipment for body temperature control according to claim 6 characterized by said magnetic member being a rubber magnet.
[Claim 8] Heat exchange equipment for body temperature control according to claim 2 characterized by arranging a heat insulator in the field of said temperature control jacket and the field of the opposite side which counter said temperature control-ed object front face.
[Claim 9] Heat exchange equipment for body temperature control according to claim 1 or 2 characterized by a part of passage [at least] which pours said liquid with which said temperature control jacket was equipped being flexible tubing.
[Claim 10] Heat exchange equipment for body temperature control according to claim 1 or 2 characterized by the heat-conduction member with which said temperature control jacket was equipped becoming with the saccate sheet which encloses a bulking agent and this bulking agent.
[Claim 11] Heat exchange equipment for body temperature control according to claim 10 characterized by being either although said saccate sheet comes to **** resin, a metal thin film, and resin and a metal thin film.
[Claim 12] It is heat exchange equipment for body temperature control according to claim 10 or 11 characterized by for the break and the divided building envelope having made the airtight space inside said saccate sheet open for free passage mutually, and enclosing a filler with the interior of this space.
[Claim 13] Heat exchange equipment for body temperature control according to claim 10 or 11 which divides said interior of a saccate sheet into two or more airtight space, and is characterized by enclosing a bulking agent with each divided space.
[Claim 14] The interior of the tube as passage which pours said at least one or more liquids is carried out to said saccate sheet. The entrance of this tube is heat exchange equipment for body temperature control given in either of claims 10, 12, or 13 characterized by enclosing a bulking agent between said tubes by which the exterior of said saccate sheet was made to penetrate with the airtight inside this saccate sheet held, and interior was carried out to this saccate sheet.
[Claim 15] Heat exchange equipment for body temperature control according to claim 14 characterized by for the tube as passage which pours said liquid having moved on said saccate sheet in a zigzag direction, and carrying out interior to it.
[Claim 16] Heat exchange equipment for body temperature control given in either of claims 10, 12, or 13 characterized by the thing of the outside surface of said saccate sheet arranged at least so that the whole surface might be touched in at least one or more tubes.
[Claim 17] Heat exchange equipment for body temperature control according to claim 16 characterized by for the tube as passage which pours said liquid having moved on said saccate sheet in a zigzag direction, and carrying out sheathing to it.
[Claim 18] Saccate isomorphism-like 2nd sheet is prepared mostly. the 1st saccate sheet with which the bulking agent was enclosed, and a bulking agent were enclosed -- Heat exchange equipment for body temperature control according to claim 10 to 17 characterized by arranging at least one or more tubes so that the outside surface of each of this saccate sheet of two sheets may be touched, and sticking the saccate sheet of two sheets mutually.

[Claim 19] Heat exchange equipment for body temperature control according to claim 18 characterized by for the tube as passage which pours said liquid having moved in a zigzag direction, and being arranged between said saccate sheets of two sheets.
[Claim 20] Heat exchange equipment for body temperature control according to claim 14 to 17 characterized by being parallel in at least two or more tubes, and pouring a liquid for the inside of interior or each tube which is made to carry out sheathing and adjoins each other to hard flow at said saccate sheet, respectively.
[Claim 21] The heat-conduction member with which said temperature control jacket was equipped is heat exchange equipment for body temperature control according to claim 1 or 2 characterized by being two or more blocks which the passage which pours said at least one or more liquids is formed, and have a curvature side almost equivalent to the curvature of a temperature control object front face in the whole surface at least.
[Claim 22] Heat exchange equipment for body temperature control according to claim 21 characterized by connecting each of a block of said plurality by the tube as passage which pours said at least one or more liquids.
[Claim 23] Heat exchange equipment for body temperature control according to claim 22 characterized by connecting said two or more blocks with the connection sheet of at least one or more sheets.
[Claim 24] Heat exchange equipment for body temperature control according to claim 23 with which said connection sheet is characterized by the thing of a heat-conduction promotion member and a magnetic material become by either at least.
[Claim 25] Said heat-conduction member is heat exchange equipment for body temperature control according to claim 1 or 2 characterized by being two or more plates which the passage which pours said at least one or more liquids is formed in contact with the outer wall, and have a curvature side almost equivalent to the curvature of a temperature control object front face.
[Claim 26] Heat exchange equipment for body temperature control according to claim 25 characterized by said plate becoming by either the looping capillary heat pipe and graphite.
[Claim 27] Heat exchange equipment for body temperature control according to claim 25 characterized by connecting each of two or more of said plates by the tube as passage which pours said at least one or more liquids.
[Claim 28] Heat exchange equipment for body temperature control according to claim 27 characterized by connecting said two or more plates with the connection sheet of at least one or more sheets.
[Claim 29] Heat exchange equipment for body temperature control according to claim 1 characterized by a temperature control-ed object being a projection lens.
[Claim 30] Heat exchange equipment for body temperature control according to claim 1 to 27 characterized by having the temperature of said liquid, and a temperature control means of said temperature control object to control one of temperature at least.
[Claim 31] Equipment possessing the heat exchange equipment for body temperature control according to claim 1 to 30, and the semiconductor-fabrication-machines-and-equipment optical system, the optical system for test equipment or the optical system for measuring devices by which temperature control is carried out with this equipment.
[Procedure amendment 3]
[Document to be Amended] Specification
[Item(s) to be Amended] 0012
[Method of Amendment] Modification
[The contents of amendment]
[0012]
The heat exchange equipment for body temperature control of this invention for solving the above-mentioned problem To a part of one [at least] heat-conduction member [at least] which transmits heat between the liquids and temperature control-ed objects by which this temperature control was carried out to the passage which pours the liquid by which temperature control was carried out The temperature control jacket which has the flexibility with which it can equip removable in said temperature control-ed object is prepared, and it is characterized by having a liquid feeder style for supplying said liquid by which temperature control was carried out.

[Procedure amendment 4]
[Document to be Amended] Specification
[Item(s) to be Amended] 0013
[Method of Amendment] Deletion
[The contents of amendment]
[Procedure amendment 5]
[Document to be Amended] Specification
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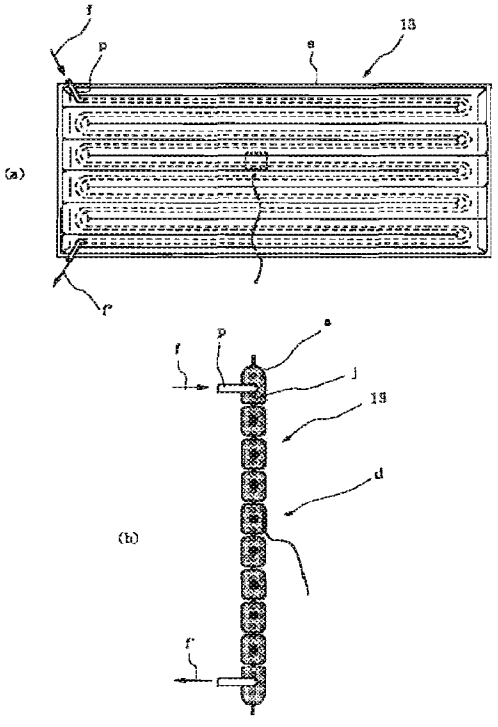
(54)【発明の名称】　物体温度調節用熱交換装置、該熱交換装置を使用して製造した投影レンズ及び該熱交換装置を使用した光学系を具備する装置

(57)【要約】
【課題】　液体を熱媒とし、メンテナンス等の際容易に着脱可能な温調ジャケットを用い、半導体製造装置を構成するユニットの表面を高精度に温度制御する。
【解決手段】　温度制御された液体ｆを流す流路を形成するチューブｐと、温度制御された液体ｆと投影レンズなどの被温度制御対象物との間で熱を伝達するための充填剤ｊ及び樹脂シートｓからなる熱伝導部材を備え、かつチューブｐと前記熱伝導部材の一部または全部が一定の柔軟性を持った着脱可能な温調ジャケット１３を用い、該温調ジャケット１３は、被温度制御対象物に装着した状態では、その被温度制御対象物を構成する側壁を取り巻く形となり、取り外した場合は、細長い帯状か、平面形状に展開できる。



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【特許請求の範囲】

【請求項１】　温度制御された液体を流す流路と、該温度制御された液体と被温度制御対象物との間で熱を伝達する熱伝導部材とを備え、かつ該液体を流す流路及び熱伝導部材の少なくともいずれか一方の少なくとも一部が柔軟性を持つ温調ジャケットを有し、該温調ジャケットが前記被温度制御対象物に着脱可能に装着され、前記液体を流す流路に温度制御された液体を供給するための液体供給機構を備えることを特徴とする物体温度調節用熱交換装置。

【請求項２】　前記被温度制御対象物から取り外した前記温調ジャケットが略平面状に展開できることを特徴とする請求項１に記載の物体温度調節用熱交換装置。

【請求項３】　前記温調ジャケットを前記被温度制御対象物表面に接して螺旋状に配設したことを特徴とする請求項２に記載の物体温度調節用熱交換装置。

【請求項４】　前記温調ジャケットの前記被温度制御対象物表面に対向する面に熱伝導促進部材を配設したことを特徴とする請求項２または３に記載の物体温度調節用熱交換装置。

【請求項５】　前記熱伝導促進部材がグラファイトでなることを特徴とする請求項４に記載の物体温度調節用熱交換装置。

【請求項６】　前記被温度制御対象物表面に対向する前記温調ジャケットの面に磁性部材を配設したことを特徴とする請求項２に記載の物体温度調節用熱交換装置。

【請求項７】　前記磁性部材がラバーマグネットであることを特徴とする請求項６に記載の物体温度調節用熱交換装置。

【請求項８】　前記被温度制御対象物表面に対向する前記温調ジャケットの面と反対側の面に断熱材を配設したことを特徴とする請求項２に記載の物体温度調節用熱交換装置。

【請求項９】　前記温調ジャケットに備えられた前記液体を流す流路の少なくとも一部が可撓性管であることを特徴とする請求項１または２に記載の物体温度調節用熱交換装置。

【請求項１０】　前記温調ジャケットに備えられた熱伝導部材が充填剤と該充填剤を封入する袋状シートでなることを特徴とする請求項１または２に記載の物体温度調節用熱交換装置。

【請求項１１】　前記袋状シートが、樹脂、金属薄膜及び樹脂と金属薄膜を積層してなるもののいずれかであることを特徴とする請求項１０に記載の物体温度調節用熱交換装置。

【請求項１２】　前記袋状シート内部の気密空間を区切り、かつ区切った内部空間は互いに連通させ、この空間内部に充填材を封入したことを特徴とする請求項１０または１１に記載の物体温度調節用熱交換装置。

【請求項１３】　前記袋状シート内部を複数の気密空間に分割し、分割したそれぞれの空間に充填剤を封入したことを特徴とする請求項１０または１１に記載の物体温度調節用熱交換装置。

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【請求項１４】　前記袋状シートに少なくとも１本以上の前記液体を流す流路としてのチューブが内装され、該チューブの出入り口は前記袋状シートの外部に、該袋状シート内部の気密を保持したまま貫通させ、該袋状シートと内装された前記チューブの間に充填剤が封入されたことを特徴とする請求項１０、１２または１３のいずれかに記載の物体温度調節用熱交換装置。

【請求項１５】　前記袋状シートに前記液体を流す流路としてのチューブが蛇行して内装されたことを特徴とする請求項１４に記載の物体温度調節用熱交換装置。

【請求項１６】　前記袋状シートの外表面の少なくとも一面に、少なくとも１本以上のチューブを接するように配設したことを特徴とする請求項１０、１２または１３のいずれかに記載の物体温度調節用熱交換装置。

【請求項１７】　前記袋状シートに前記液体を流す流路としてのチューブが蛇行して外装されたことを特徴とする請求項１６に記載の物体温度調節用熱交換装置。

【請求項１８】　充填剤が封入された第１の袋状シートと、充填剤が封入されたほぼ同形状の第２の袋状シートを設け、少なくとも１本以上のチューブを、この２枚の袋状シートそれぞれの外表面に接するように配設し、かつ２枚の袋状シートを互いに貼り合わせたことを特徴とする請求項１０～１７のいずれかに記載の物体温度調節用熱交換装置。

【請求項１９】　前記２枚の袋状シートの間に前記液体を流す流路としてのチューブが蛇行して配設されたことを特徴とする請求項１８に記載の物体温度調節用熱交換装置。

【請求項２０】　少なくとも２本以上のチューブを平行して前記袋状シートに内装または外装させ、隣り合うそれぞれのチューブ内をそれぞれ逆方向に液体を流すことを特徴とする請求項１４～１７のいずれかに記載の物体温度調節用熱交換装置。

【請求項２１】　前記温調ジャケットに備えられた熱伝導部材は、少なくとも１本以上の前記液体を流す流路が形成され、かつ温度制御対象物表面の曲率とほぼ同等の曲率面を少なくともその一面に持つ複数のブロックであることを特徴とする請求項１または２に記載の物体温度調節用熱交換装置。

【請求項２２】　前記複数のブロックのそれぞれを、少なくとも１本以上の前記液体を流す流路としてのチューブで連結したことを特徴とする請求項２１に記載の物体温度調節用熱交換装置。

【請求項２３】　前記複数のブロックを少なくとも１枚以上の連結シートで連結したことを特徴とする請求項２２に記載の物体温度調節用熱交換装置。

【請求項２４】　前記連結シートが熱伝導促進部材及び

磁性材料の少なくともいずれかでなることを特徴とする請求項２３に記載の物体温度調節用熱交換装置。

【請求項２５】　前記熱伝導部材は、少なくとも１本以上の前記液体を流す流路がその外壁に接して形成され、かつ温度制御対象物表面の曲率とほぼ同等の曲率面を持つ複数の板状体であることを特徴とする請求項１または２に記載の物体温度調節用熱交換装置。

【請求項２６】　前記板状体がループ型細管ヒートパイプ及びグラファイトのいずれかでなることを特徴とする請求項２５に記載の物体温度調節用熱交換装置。

【請求項２７】　複数の前記板状体のそれぞれを、少なくとも１本以上の前記液体を流す流路としてのチューブで連結したことを特徴とする請求項２５に記載の物体温度調節用熱交換装置。

【請求項２８】　前記複数の板状体を少なくとも１枚以上の連結シートで連結したことを特徴とする請求項２７に記載の物体温度調節用熱交換装置。

【請求項２９】　被温度制御対象物が投影レンズであることを特徴とする請求項１に記載の物体温度調節用熱交換装置。

【請求項３０】　前記液体の温度及び前記温度制御対象物の少なくともいずれかの温度を制御する温度制御手段を備えることを特徴とする請求項１～２７のいずれかに記載の物体温度調節用熱交換装置。

【請求項３１】　請求項１～３０のいずれかに記載の物体温度調節用熱交換装置を使用した半導体製造装置、検査装置及び測定装置のうちのいずれかの光学系を具備する装置。

【請求項３２】　請求項１～３０のいずれかに記載の物体温度調節用熱交換装置を利用して製造されたことを特徴とする投影レンズ。

【請求項３３】　請求項１～３０のいずれかに記載の物体温度調節用熱交換装置を利用して製造された投影レンズを具備することを特徴とする露光装置。

【請求項３４】　請求項３３に記載の露光装置を含む各種プロセス用の製造装置群を半導体製造工場に設置する工程と、該製造装置群を用いて複数のプロセスによって半導体デバイスを製造する工程とを有することを特徴とする半導体デバイス製造方法。

【請求項３５】　前記製造装置群をローカルエリアネットワークで接続する工程と、前記ローカルエリアネットワークと前記半導体製造工場外の外部ネットワークとの間で、前記製造装置群の少なくとも１台に関する情報をデータ通信する工程とをさらに有することを特徴とする請求項３４に記載の半導体デバイス製造方法。

【請求項３６】　前記露光装置のベンダもしくはユーザが提供するデータベースに前記外部ネットワークを介してアクセスしてデータ通信によって前記製造装置の保守情報を得る、もしくは前記半導体製造工場とは別の半導体製造工場との間で前記外部ネットワークを介してデータ通信して生産管理を行うことを特徴とする請求項３５に記載の半導体デバイス製造方法。

【請求項３７】　請求項３３に記載の露光装置を含む各種プロセス用の製造装置群と、該製造装置群を接続するローカルエリアネットワークと、該ローカルエリアネットワークから工場外の外部ネットワークにアクセス可能にするゲートウェイを有し、前記製造装置群の少なくとも１台に関する情報をデータ通信することを可能にしたことを特徴とする半導体製造工場。

【請求項３８】　半導体製造工場に設置された請求項３３に記載の露光装置の保守方法であって、前記露光装置のベンダもしくはユーザが、半導体製造工場の外部ネットワークに接続された保守データベースを提供する工程と、前記半導体製造工場内から前記外部ネットワークを介して前記保守データベースへのアクセスを許可する工程と、前記保守データベースに蓄積される保守情報を前記外部ネットワークを介して半導体製造工場側に送信する工程とを有することを特徴とする露光装置の保守方法。

【請求項３９】　請求項３３に記載の露光装置において、ディスプレイと、ネットワークインタフェースと、ネットワーク用ソフトウェアを実行するコンピュータとをさらに有し、露光装置の保守情報をコンピュータネットワークを介してデータ通信することを可能にしたことを特徴とする露光装置。

【請求項４０】　前記ネットワーク用ソフトウェアは、前記露光装置が設置された工場の外部ネットワークに接続され前記露光装置のベンダもしくはユーザが提供する保守データベースにアクセスするためのユーザインタフェースを前記ディスプレイ上に提供し、前記外部ネットワークを介して該データベースから情報を得ることを可能にすることを特徴とする請求項３９に記載の露光装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は高い温度安定性や温度制御性を要する物体温度調節用熱交換装置等に関し、特に高精度な光学的計測を行う半導体検査装置や測定装置、また半導体集積回路や液晶パネルを製造するために使用される露光装置等に関し、さらに詳細には温度制御装置を使用して製造する投影光学系の製造工程や、投影光学系用の温度制御装置を備えた投影露光装置に利用して好適である。

【０００２】

【従来の技術】半導体集積回路線幅の微細化が進み、今や０．１μｍ台の線幅パターンの形成が量産レベルで実現しつつある。この微細なパターンを形成するために、より高精度な結像性能と重ね合わせ精度が投影露光装置に要求されている。露光装置のレチクルとウエハの重ね合わせ精度においては、ウエハを搭載するウエハステー

ジ位置の測長精度が非常に重要な誤差因子の一つとなる。この位置の精密測長にはレーザ干渉計式測長器を使用するのが一般的であり、レーザ光路雰囲気の屈折率変化、特に温度変化が測長誤差に悪影響を及ぼす。またレーザ干渉計式測長器の構成部材である干渉計や反射鏡を固定する構造体の温度変動に起因する微妙な熱変形もまたこの測長誤差に悪影響を及ぼす。他にもオフアクシスアライメントにおいては、オフアクシスアライメント顕微鏡と投影光学系間の距離の変動が、各々を支える構造体の熱変形によって起こされ、この構造体の熱変形が重ね合わせ精度を劣化させる要因となっている。一方、複数の単レンズを所定の間隔で積み重ねて成る投影光学系は、レンズに使用する硝材の屈折率や、レンズ間の空隙に存在する空気などの気体の屈折率、レンズ間隔を一定に保持する構造材料の長さなどが、温度によって変化するため、倍率・焦点・像の歪み等の投影光学系の結像性能は周囲温度によって敏感に変化する。

【０００３】投影露光装置以外にも、重ね合わせ検査装置やレチクル上のパターンの寸法等を計測するためのレチクル座標測定装置、物体特に光学部材の表面形状を測定するための面形状測定装置においてもレーザ干渉計が用いられており、レーザ光路雰囲気の温度変化や構造体の熱変形は、これらの装置の計測精度を劣化させる要因となっていた。

【０００４】このため、従来の投影露光装置や半導体検査装置、測定装置等の光学系を含んでいる装置では、装置全体またはその一部あるいはその両方を温度制御された環境チャンバで取り囲み、装置が置かれる環境温度を一定に制御することが積極的に行われている。

【０００５】図２０は従来の露光装置の一例である。露光装置本体上では不図示の露光光源から射出された光が照明光学系１で所定の光束に形成された後、レチクル２を照射する。照射されたレチクル２上の回路パターンは投影レンズ３によりウエハステージ５上に載置されたウエハ４上に結像され、ウエハ４の表面に塗布されたレジストを感光させる。また、露光装置本体の構造体１２には投影レンズ３や、ウエハ４上やウエハステージ５上のアライメントマークを観察・位置計測するためのオフアクシス顕微鏡６、ウエハステージ５上に載置された基準ミラー７の位置を計測するためのレーザ干渉計８やそれを支持する支柱９、さらにはレーザ干渉計用の光源１０が直接または間接的に締結されている。

【０００６】また、露光装置本体は不図示の環境チャンバの中に設置されており、露光装置を取り巻く環境は所定の温度に保たれている。またウエハステージ５や干渉計８を取り巻く空間や、投影レンズ３を取り巻く空間にはさらに個別に温度制御された空調空気を吹き込んで、より環境温度を高精度に維持することが必要に応じて実施されていた。

【０００７】

【発明が解決しようとする課題】しかしながら、投影露光装置を例にとると、投影光学系や干渉計、オフアクシスアライメント顕微鏡等を支持する投影露光装置本体の構造体やその周囲にはレーザ干渉測長器用のレーザ光源や種々の電気基板、さらには駆動用アクチュエータなどの発熱源が存在し、投影光学系はその影響を受けやすく、環境チャンバの空調温度の制御では、重ね合わせ精度や投影光学系に要求される温度精度を維持することは困難な状況になってきている。周囲熱源によって暖められた空気からの熱伝達による影響だけではなく、例えば投影露光装置本体の構造体がこれら熱源の影響により０．１℃～０．２℃程度環境チャンバの設定温度より高くなってしまい、この構造体により直接または間接に支持される投影光学系は構造体自体からの熱伝導によって同等の温度差が周囲環境に比べて発生してしまい、所定の結像性能が得られないという問題があった。さらにこの構造体の温度が周囲熱源の稼動状況によって変化し、微妙な経時熱変形がこの構造体に発生するため、この構造体より直接または間接に支持される干渉計やオフアクシス顕微鏡などの位置がずれてしまい、重ね合わせ精度に誤差を発生させる原因となっていた。さらにはオフアクシス顕微鏡自身の経時熱変形が重ね合わせ精度に誤差を発生させる原因となる場合があった。

【０００８】また、投影光学系は、投影露光装置本体に組み込む前に、投影光学系単体を１つのユニットとして組み立て、調整する工程を経て成る。この投影光学系単体を調整する工程では、生産設備としての工具的な露光装置や透過波面測定装置に投影光学系を搭載して、実際の結像性能を確認しつつ、それに基づいて所定の結像性能が得られるよう、調整方法を選択し調整量を算出する。しかしながら、種々の調整工程を経て、この工具的な露光装置や透過波面測定装置に搭載された状態で、所定の結像性能が得られた投影露光系を、投影露光装置本体の構造体に搭載したところ、単体での結像性能が再現せず所定の性能が得られないという問題があった。この現象を調査したところ、工具的な露光装置や透過波面測定装置に搭載された状態での投影光学系の温度と、投影露光装置本体に搭載された状態での温度とが、平均値や分布で異なることが主原因であることが判明した。

【０００９】ここで投影光学系を所定の温度に制御する方法としては、特開平０９－０８２６２１号公報に記載の発明にあるように、投影光学系鏡筒側壁内に流路を形成し、温度制御された液体を流すことが考えられる。しかし、この鏡筒側壁内に流路を形成することは、部品のコストが非常に高くなる欠点があった。さらに投影光学系ユニットの調整工程では、投影光学系内に収容された複数のレンズ群を時には回転させたり、時にはレンズ間隔を変更するなどの投影光学系を分解する作業が伴う。投影光学系鏡筒の側壁に液体流路が形成されている場合、これら分解作業を伴う調整工程を行う毎に、この流

路に残存する液体を取り除き、流路自体を分解する余計な作業を伴い、投影光学系の生産性が悪化するという欠点があった。

【００１０】またこの液体による温度制御を応用し、重ね合わせ精度に影響を与える熱源となりうる干渉計レーザヘッドや電気基盤、駆動用アクチュエータなどの各種部材やその熱的影響によって熱変形を生じる構造体やオフアクシスアライメント顕微鏡や、干渉計の何れか一方または両方に対して、これらの側壁に流路を形成し、温度制御された液体をこの流路に流すことで温度変動を抑えることは容易に考えられるが、実際にこれら側壁内部に流路を形成することは部品のコストが非常に高くなり、また内部の修理やメンテナンスを行う際に、一々この流路に残存する液体を取り除き、流路自体を分解する余計な作業を伴い、投影露光装置の生産性が悪化するという欠点があった。

【００１１】本発明は、半導体製造装置を構成する光学系ユニット等の表面を高精度に温度制御し、かつメンテナンス等の際に、容易に着脱可能な液体を媒体とする温調ジャケットを有する物体温度調節用熱交換装置等を提供することを目的とする。

【００１２】

【課題を解決するための手段】上記問題を解決するために、本発明に係る物体温度調節用熱交換装置では、温度制御された液体を流す流路と、該温度制御された液体と被温度制御対象物との間で熱を伝達する熱伝導部材とを備え、かつ該液体を流す流路及び熱伝導部材の少なくともいずれか一方の少なくとも一部が柔軟性を持つ温調ジャケットを有し、該温調ジャケットが前記被温度制御対象物に着脱可能に装着され、前記液体を流す流路に温度制御された液体を供給するための液体供給機構を備えることを特徴とする。

【００１３】前記被温度制御対象物から取り外した前記温調ジャケットは略平面状に展開できることが望ましく、前記温調ジャケットを前記被温度制御対象物表面に接して螺旋状に配設することとしてもよく、前記温調ジャケットの前記被温度制御対象物表面に対向する面に熱伝導促進部材を配設してもよく、前記熱伝導促進部材はグラファイトでなることが好ましい。

【００１４】また、本発明は、前記被温度制御対象物表面に対向する前記温調ジャケットの面に磁性部材を配設してもよく、前記磁性部材がラバーマグネットであることが望ましく、前記被温度制御対象物表面に対向する前記温調ジャケットの面と反対側の面に断熱材を配設することが好ましい。

【００１５】また、本発明は、前記温調ジャケットに備えられた前記液体を流す流路の少なくとも一部が可撓性管であることが望ましく、前記温調ジャケットに備えられた熱伝導部材が充填剤と該充填剤を封入する袋状シートでなることが好ましく、前記袋状シートは、樹脂、金属薄膜及び樹脂と金属薄膜を畳重してなるもののいずれであってもよく、前記袋状シート内部の気密空間を区切り、かつ区切った内部空間は互いに連通させ、この空間内部に充填材を封入することとしてもよく、前記袋状シート内部を複数の気密空間に分割し、分割したそれぞれの空間に充填剤を封入することとしてもよい。

【００１６】また、前記袋状シートに少なくとも１本以上の前記液体を流す流路としてのチューブが内装され、該チューブの出入り口は前記袋状シートの外部に、該袋状シート内部の気密を保持したまま貫通させ、該袋状シートと内装された前記チューブの間に充填剤が封入されることが望ましく、前記袋状シートに前記液体を流す流路としてのチューブが蛇行して内装されることが望ましく、前記袋状シートの外表面の少なくとも一面に、少なくとも１本以上のチューブを接するように配設してもよく、前記袋状シートに前記液体を流す流路としてのチューブが蛇行して外装されてもよく、充填剤が封入された第１の袋状シートと、充填剤が封入されたほぼ同形状の第２の袋状シートを設け、少なくとも１本以上のチューブを、この２枚の袋状シートそれぞれの外表面に接するように配設し、かつ２枚の袋状シートを互いに貼り合わせたことを特徴としてもよく、前記２枚の袋状シートの間に前記液体を流す流路としてのチューブが蛇行して配設されたことを特徴としてもよく、少なくとも２本以上のチューブを平行して前記袋状シートに内装または外装させ、隣り合うそれぞれのチューブ内をそれぞれ逆方向に液体を流すことが好ましい。

【００１７】また、前記温調ジャケットに備えられた熱伝導部材は、少なくとも１本以上の前記液体を流す流路が形成され、かつ温度制御対象物表面の曲率とほぼ同等の曲率面を少なくともその一面に持つ複数のブロックであることが望ましく、前記複数のブロックのそれぞれを、少なくとも１本以上の前記液体を流す流路としてのチューブで連結してもよく、前記複数のブロックを少なくとも１枚以上の連結シートで連結してもよい。前記熱伝導部材は、少なくとも１本以上の前記液体を流す流路がその外壁に接して形成され、かつ温度制御対象物表面の曲率とほぼ同等の曲率面を持つ複数の板状体であることが好ましい。また、本発明は、前記板状体がループ型細管ヒートパイプ及びグラファイトのいずれかでなることとしてもよく、複数の前記板状体のそれぞれを、少なくとも１本以上の前記液体を流す流路としてのチューブで連結することが可能であり、前記複数の板状体を少なくとも１枚以上の連結シートで連結してもよく、被温度制御対象物が投影レンズであることとすることができ、前記液体の温度及び前記温度制御対象物の少なくともいずれかの温度を制御する温度制御手段を備えることが好ましい。

【００１８】また、本発明に係る物体温度調節用熱交換装置は、半導体製造装置、検査装置及び測定装置のいず

れの光学系を具備する装置にも使用することができ、本発明に係る物体温度調節用熱交換装置を利用して投影レンズを製造することもでき、本発明は、当該物体温度調節用熱交換装置を利用して製造された投影レンズを具備する露光装置も含む。

【００１９】また、本発明は、前記露光装置を含む各種プロセス用の製造装置群を半導体製造工場に設置する工程と、該製造装置群を用いて複数のプロセスによって半導体デバイスを製造する工程とを有する半導体デバイス製造方法にも適用可能であり前記製造装置群をローカルエリアネットワークで接続する工程と、前記ローカルエリアネットワークと前記半導体製造工場外の外部ネットワークとの間で、前記製造装置群の少なくとも１台に関する情報をデータ通信する工程とをさらに有する半導体デバイス製造方法にも適用することができ、前記露光装置のベンダもしくはユーザが提供するデータベースに前記外部ネットワークを介してアクセスしてデータ通信によって前記製造装置の保守情報を得る、もしくは前記半導体製造工場とは別の半導体製造工場との間で前記外部ネットワークを介してデータ通信して生産管理を行う半導体デバイス製造方法にも適用できる。

【００２０】また、本発明は、前記露光装置を含む各種プロセス用の製造装置群と、該製造装置群を接続するローカルエリアネットワークと、該ローカルエリアネットワークから工場外の外部ネットワークにアクセス可能にするゲートウェイを有し、前記製造装置群の少なくとも１台に関する情報をデータ通信することを可能にした半導体製造工場に適用でき、当該半導体製造工場に設置された前記露光装置の保守方法であって、前記露光装置のベンダもしくはユーザが、半導体製造工場の外部ネットワークに接続された保守データベースを提供する工程と、前記半導体製造工場内から前記外部ネットワークを介して前記保守データベースへのアクセスを許可する工程と、前記保守データベースに蓄積される保守情報を前記外部ネットワークを介して半導体製造工場側に送信する工程とを有する露光装置の保守方法にも適用でき、該露光装置において、ディスプレイと、ネットワークインタフェースと、ネットワーク用ソフトウェアを実行するコンピュータとをさらに有し、露光装置の保守情報をコンピュータネットワークを介してデータ通信することを可能にすることが望ましい。

【００２１】前記ネットワーク用ソフトウェアは、前記露光装置が設置された工場の外部ネットワークに接続され前記露光装置のベンダもしくはユーザが提供する保守データベースにアクセスするためのユーザインタフェースを前記ディスプレイ上に提供し、前記外部ネットワークを介して該データベースから情報を得ることを可能にすることが好ましい。

【００２２】

【発明の実施の形態及び作用】前記温調ジャケットは、被温度制御対象物に装着した状態では、その被温度制御対象物を構成する側壁を取り巻く形となる。例えば、この被温度制御対象物が投影光学系の場合には、その鏡筒側壁を取り巻くように略円筒形または略円錐形、さらには両者の組み合わせのいずれかの形となり、取り外す場合は細長い帯状か、鏡筒部が中空となった略円筒形または略円錐形を平面展開または複数の円弧形状を開いた形となることを特徴とする。また、例えばこの被温度制御対象物が投影露光装置本体の構造体やオフアクシスアライメント顕微鏡等の場合には、平面形状であったり箱状体を包む形となる。箱状体を包む形の場合は、平面形状の温調ジャケットを複数使用するか、少なくともこの箱状体の２面以上を平面展開した形状を特徴とする。

【００２３】また、このとき展開によって分断された線の両者に跨がった流路は形成されていない。また、この分断された線を境に両者を結合する部材が備えられており、被温度制御対象物への着脱が容易に行える構造となっている。

【００２４】さらに必要に応じてこの温調ジャケット内部には温度センサが設けられる場合があり、温度センサによって検知された温度に基づいて液体供給機構により供給する液体の温度を温度制御手段によって制御する。

【００２５】温度制御された液体には、給排熱によって生ずる温度差を小さくするため、比較的熱容量の大きいものであって、かつ流し易く配管抵抗が小さいものが良い。電気系近傍を流路が通る場合には、漏液時の事故を最小限に抑えるために絶縁性のある液体であることが望ましい。具体的には水、純水、プロピレングリコール水溶液や弗化液が考えられる。また、漏液時の故障や危険性を最小限に抑えるために、漏液検知用センサをこの温調ジャケットの表面や温度制御された液体を流す流路の外表面に設けると尚良い。この温調ジャケットには種々の構成が考えられる。

【００２６】樹脂シートまたは金属薄膜と樹脂シートを複合してなる柔軟性気密シートを矩形や扇形状を持つ袋状に形成し、この中に熱伝導材料を充填する。熱伝導材料としては純水、弗化液体、プロピレングリコール水溶液、シリコーン油などの液体や、保冷材等に使用されている水や油と高分子材料を混合してなる高分子ゲル、さらには水銀に代表される液体金属など比較的熱伝導率が高く熱容量の大きい物質で、さらに入れた容器の形に倣い易いものが良い。充填した熱伝導材料はこの柔軟性気密シートによって密閉された形となり、またなるべく空気が入らないようにすることが好ましい。この熱伝導材料に接するように温度制御された液体を流す流路を前記柔軟性気密シート内に形成する。この流路には簡単に曲げられる樹脂チューブや金属チューブを使用し、左右または上下に往復・蛇行しながら柔軟性気密シート全体に均一に配置されている。少なくとも１本の連続するチューブを往復・蛇行させながら柔軟性気密シートに配置さ

せれば良く、この場合は１つずつの温度制御された液体の出口及び入口が、この蛇行する流路の両端に連通して柔軟性気密シートの外に設けられている。

【００２７】また、この流路が長い場合は、投影光学系の温度制御上、液体の出入り口での温度差が無視できないことが有り得る。この場合は２本の連続するチューブを隣り合わせたうえで往復・蛇行させながら柔軟性気密シートに配置させ、温度制御された液体の出入り口を２つずつ袋状シートの外に設ける。例えは、袋状シートの上方と下方に２つずつの出入り口を設けた場合、それに連通する気密シート内部のチューブの一方は下方を入口に上方を出口として温度制御された液体を概略上方に流し、他方のチューブは上方を入口に下方を出口として温度制御された液体を概略下方に流す。即ち、隣り合った２本のチューブ内での液体の流れる方向を互いに逆にすることにより、出入り口の温度差を打ち消し合う効果が期待できる。また、これとは別に、柔軟性気密シート内部に引回すチューブを出入り口の温度差が無視できる程度の長さに予め設定し、複数本のチューブとその数に対応した出入り口で構成しても良い。

【００２８】また、被温度制御対象物が投影光学系鏡筒などの円筒や円錐形状である場合には、柔軟性袋状シートの形状を、内部に通す温度制御された液体の流路である柔軟性チューブよりは、幅の広い帯状に形成した温調ジャケットとし、投影光学系鏡筒の外壁に沿って螺旋状にこの帯状温調ジャケットを巻き付けることも考えられる。

【００２９】また他に、円筒あるいは円錐形状をもつ投影光学系鏡筒の外壁の曲率とほぼ同じ曲率を少なくとも一面に設けたブロックを複数個有し、このブロック内部には少なくとも一本の温度制御された液体を流す流路を形成する。このブロック端面の流路の出入り口には柔軟性チューブが接続されており、この柔軟性チューブによって複数個のブロックを互いに連結させている。この柔軟性チューブによって互いに連結された複数個のブロックを平面に広げた状態での形は、細長い帯状や、縦横に並べた矩形状や扇形状となる。これを投影光学系鏡筒外壁に螺旋状あるいは環状に巻き付け、固定部材で固定する。このブロックの一面に設けられた曲率を平面にすることで、構造体やオフアクシス顕微鏡用とすることもできる。さらに柔軟性チューブとブロック内の流路で構成される温度制御された液体の流路や全体としての出入り口の数は、被温度制御対象物とのブロックの接触面積や温度分布などの必要とする温度制御精度に合せて複数本構成すれば良い。

【００３０】また、このブロックは熱伝導率や熱容量の比較的大きい金属であることが望ましく、アルミニウムや銅あるいはそれを主材とした合金であれば尚良い。

【００３１】また他に、前記ブロックを被温度制御対象物の外壁の曲率とほぼ同じ曲率をもつ板状体に置き換え、この板状体の外側に流路となる配管を接触するように設け、この配管の両端を柔軟性チューブによって連結した複数個の板状体によって前記細長い帯状や、縦横に並べた矩形状や扇形状に仕立てても良い。板状体はアルミニウムや銅あるいはそれを主材とした合金等熱伝導率の比較的大きい金属であることが望ましい。もちろんこの曲率が平面である場合もある。

【００３２】また、これら種々の温調ジャケットの被温度制御対象物側壁に接触する面に、厚み方向に比べて平面方向の熱伝導率が大きい熱伝導促進部材を構成することにより、温度制御性、とくに装着時の被温度制御対象物側壁の温度均一性を向上させることができる。

【００３３】熱伝導促進部材としてはグラファイトシートや板状のループ型細管ヒートパイプがある。なお、グラファイトシート自身は表面から発塵する可能性があるため、これを避ける場合は最外面を別の樹脂または金属薄膜で覆えば良い。

【００３４】また、ここでは被温度制御対象物を投影光学系や構造体、オフアクシスアライメント顕微鏡としたが、投影露光装置本体構造体やその周辺に点在する干渉計レーザヘッドや種々の電気基板などの重ね合わせ精度や結像性能に悪影響を及ぼす熱源の温度制御手段や冷却手段として用いても良い。前記温調ジャケットの被温度制御対象物表面に対向する面にラバーマグネットなどの磁性部材を配設することも可能である。

【００３５】本発明によれば、温度制御手段によって温度制御された液体が液体供給機構によって温調ジャケット内部に形成された液体流路に導かれる。液体流路外周を取り巻く熱伝導部材を介して、液体供給機構によって導かれた液体と被温度制御対象物の間で熱交換が行われ、この被温度制御対象物の温度が予め設定された所定の温度に一定に保たれる。

【００３６】この温度制御された液体を利用して被温度制御対象物の温度制御を行う温度制御手段において、この液体と被温度制御対象物間の熱交換を行う手段として、温度制御された液体を流す流路と、温度制御された液体と被温度制御対象物との間で熱を伝達する熱伝導部材を備え、かつこの流路と熱伝導部材のいずれか一方または両方の一部または全部が一定の柔軟性を持った着脱簡単な温調ジャケットを用いることにより、円筒や円錐形状を持つ投影光学系はもとより、複雑な凹凸表面や微妙な曲率形状を持つ被温度制御対象物に対して、熱伝導部材をその側壁に十分密着させることができ、従って接触熱抵抗を小さくでき、高効率な温度制御が可能となる。またさらにこの温調ジャケットは平面展開が可能であることから、装置本体に搭載されているか否かに拘わらず、被温度制御対象物からの着脱が容易に行え、被温度制御対象物のメンテナンスや修理を比較的簡単に行うことが可能となる。

【００３７】

【実施例】図１は本発明に係る物体温度調節用熱交換装置を露光装置の投影レンズに適用した場合の、第１の実施例を示す斜視図である。この熱交換装置は、投影レンズ３の鏡筒外壁を温調ジャケット１３で取り囲んでいる。この温調ジャケット１３は所定の温度に調節された液体ｆを流すための柔軟性のある流路としてのチューブｐと、該チューブｐ内を流れる液体ｆと投影レンズ３の鏡筒外壁との間で熱を伝達し熱交換を行うための熱伝導部材としての中間媒質である充填剤ｊと、この充填剤ｊを封じ込めかつ充填剤ｊを投影レンズ３の鏡筒外壁の形状に概略倣わせるための柔軟性のある樹脂シートｓとで少なくとも構成されている。投影レンズ３から取り外したとき、この温調ジャケット１３は，図２（ａ）で表されるとおり概略平板状に展開できる。図２（ａ）及びその断面図である図２（ｂ）を用いてこの温調ジャケット１３の詳細について以下に説明する。

【００３８】袋状シートとしての樹脂シートｓには充填剤ｊが封入されている。充填剤ｊには純水、フッ素系不活性液体、シリコーン油、液体金属や一般的な保冷剤が使用される。液体金属、純水やシリコーン油は熱伝導性に優れ、熱交換効率を高める効果が期待できる。フッ素系不活性液体は電気絶縁性に優れるため、特に漏液時に短絡事故等の危険を回避する必要のある場合等に利用して好適である。保冷剤は熱容量が大きいため他の液体以上の蓄熱効果が期待できる。この充填剤ｊを封入するための樹脂シートｓにはポリエチレンやナイロン等単一または複数種の樹脂材料を多層構造にしたものや、それに金属薄膜を追加した高強度高気密性のバリヤシート等が適当である。

【００３９】また、この樹脂シートｓを袋状に加工するには熱融着が利用でき、加工後の気密性も充分確保することが可能である。この充填剤ｊが封入された樹脂シートｓ内には所定の温度に調節された液体ｆを流すための柔軟性のあるチューブｐが、この充填剤ｊを縫うように蛇行して内装されている。図２（ａ）では温調ジャケット１３の長手方向に平行にチューブｐを引き回しているが、温調ジャケット１３全体の曲げ半径など実装の都合に合わせて長手方向に直交ないしは斜めにチューブｐを引き回しても良い。チューブｐには液体を流すための耐圧が確保できかつ柔軟性のあるポリウレタン樹脂やポリエチレン樹脂、フッ素樹脂等の材料が使用される。このチューブｐの両端は樹脂シートｓを貫通し、その両端が液体ｆの出入り口となる。もちろんこのチューブｐが樹脂シートｓを貫通する部分は熱融着やカシメ、接着等を利用することにより充分な気密性が確保され、充填剤ｊが漏れ出ることはない。

【００４０】また、この温調ジャケット１３は使用する姿勢に制約なく形状が維持できるよう、特に厚みが一定となるよう必要に応じて樹脂シートｓ内の空間を小さく分離させている。これは温調ジャケット１３を構成する表裏両面の樹脂シートｓを諸所で互いに接合させることで実現させている。また、必要に応じてこの温調ジャケット１３の投影レンズ３の鏡筒外壁に接する側の表面には温度センサｄが取り付けられており、温調ジャケット１３や投影レンズ３の鏡筒外壁の温度を高精度に検知することができる。

【００４１】不図示の液体温度コントローラにより所定の温度に調節された液体ｆはチューブｐの入口から温調ジャケット１３内に流れ込む。流れ込んだ液体ｆは充填剤ｊ及び樹脂シートｓを介して、接する投影レンズ３の鏡筒外壁と熱交換を行いながら温調ジャケット１３の出口に到達する。温調ジャケット１３を出た液体ｆは再度不図示の液体温度コントローラにより所定の温度に調節され、温調ジャケット１３内に流れ込む。このように液体温度コントローラと温調ジャケット１３を液体ｆが循環することにより、投影レンズ３は所定の温度に保たれる。また、必要に応じて温調ジャケット１３に取り付けられた温度センサｄによって計測される温度を所定の温度となるように液体ｆの温度を液体温度コントローラで調節することも可能である。

【００４２】また、図３はこの温調ジャケットの第２の実施例を示す平面図である。第１の実施例に対し温調ジャケット内を引き回すチューブｐを２本とした点が異なる。チューブｐを２本平行に引き回し、その一方のチューブをｐ１、他方をｐ２とする。チューブｐ１，ｐ２は、それぞれに温度制御された液体ｆ１，ｆ２を互いに逆方向となるように流すことで熱交換によって生じる液体の出入り口の温度差に起因した温調ジャケット１３の温度ムラを解消することができる。図３では、２本のチューブｐ１，ｐ２に対して液体の出入り口を２組用意しているが、チューブｐ１の出口とチューブｐ２の入口を接続して液体ｆの出入り口を一組にし、２本のチューブを往復するように液体ｆを流しても同様の効果が得られる。さらに１本のチューブで同様の引き回しをして出入り口以外のチューブを完全に樹脂シートｓ内に収納しても良い。

【００４３】図４（ａ）は本発明の第３の実施例に係る温調ジャケットを示す平面図、図４（ｂ）はその断面図である。第１の実施例では温度制御された液体ｆを流すためのチューブｐを樹脂シートｓ内に収納したが、第３の実施例に係る温調ジャケット１３では、樹脂シートｓに対しチューブｐを外装させている。袋状の樹脂シートｓの表裏面を接合して複数の空間を作り、その複数の空間に充填剤ｊを充填して封止したうえで、複数の空間に分離した線上の接合面に沿って温度制御された液体ｆを流すためのチューブｐを、樹脂シートｓの外側から埋設させる。温度制御された液体ｆはチューブｐの壁面及び樹脂シートｓを介して充填剤ｊと熱交換される。さらに充填剤ｊは樹脂シートｓを介してこの温調ジャケット１３と接する投影レンズ３の鏡筒外壁と熱交換を行うこと

により、投影レンズ３は所定の温度に保たれる。

【００４４】図４（ａ）では充填剤ｊを封入する空間を複数の帯状に分割しているが、さらにそれと直交する方向にも分割して空間の分割数を増やし、より温調ジャケット１３の形状を安定化させることも可能である。また外装させるチューブｐについても１本ないし複数本のチューブｐで格子状に外装させればさらに熱交換率を向上させることが期待できる。

【００４５】また、外装させるチューブｐと樹脂シートｓを接着することも可能である。接着によりチューブｐの脱落を防止できると共に接触熱抵抗を小さくすることができ、熱交換効率を高めることができる。またチューブｐの脱落防止だけであれば、樹脂や金属薄膜でできたフィルムをチューブｐの挿入面の樹脂シートｓに全体にわたって貼り付けることも可能である。このようにチューブｐを外装させることにより、樹脂シートｓの袋状の加工やチューブｐの引き回し作業が簡単になり加工コストの低減が見込める。

【００４６】またさらに図４（ｃ）のように、充填剤ｊが封入された樹脂シートｓを２枚用意し、この２枚の樹脂シートｓの間にチューブｐを引き回し、これらを接着によって互いに密着するように接合することでも、同様な加工コストの低減が期待できる。

【００４７】これら第１～第３の実施例に係る温調ジャケットでは外表面が樹脂シートｓで覆われていたが、面方向の熱伝導率が非常に高いグラファイトを材料に含むシートを必要に応じてその外表面に貼り付けることで温調ジャケット１３の温度分布をさらに均一化することが可能である。また、使用する環境温度によっては、投影レンズ３の鏡筒外壁と接する温調ジャケット１３の面の反対側の面に断熱材を貼り付けることにより熱効率を向上させることが可能である。

【００４８】以上第１～第３の実施例では、投影レンズ３を構成する円筒形状の鏡筒外壁の温調を対象に述べてきた。実際の投影レンズ３の鏡筒は円筒形状だけではなく、円錐形状部も含まれることがある。第４の実施例として円錐形状に対応した温調ジャケットの一例を図５に示す。温調ジャケット１３の外形を、円錐形状を展開した扇形状とすることで装着時に円錐形状に倣い効果的な温調が可能となる。

【００４９】また、図６は本発明を露光装置の投影レンズ３に適用した場合の、第５の実施例を示す斜視図である。帯状に加工した温調ジャケット１３を投影レンズ３の鏡筒外壁に螺旋状に巻き付ける。この場合、鏡筒は円筒形状に限らず円錐形状や複雑な凹凸がある場合にも対応できる。図７及び図８はこの帯状に加工した温調ジャケットの詳細を示す平面図である。基本的な構造は図２（ａ）や図４（ｂ）に示すものと同じであるが、帯状としたことで加工がし易くなり、さらに加工コストの低減が見込める。

【００５０】また、図９は本発明に係る温調ジャケットを露光装置の投影レンズ３に適用した場合の、第６の実施例を示す斜視図、図１０（ａ）は温調ジャケットの平面図、図１０（ｂ）はその断面図、図１０（ｃ）は図１０（ａ）の背面図である。本実施例は、前記第１～第５の実施例に対し、温調ジャケット１３を構成する充填剤ｊとそれを封入する樹脂シートｓの代わりに、投影レンズ３の鏡筒外壁の曲率とほぼ同じ曲率を少なくとも一面に設けたブロックＢＬを複数個構成し、このブロックＢＬを主熱伝導部材とした点が異なる。投影レンズ３から取り外したとき、この温調ジャケット１３は図１０（ａ）で表されるとおり、温度制御された液体ｆが流れるチューブｐを取り外すことなく概略平板状に展開できる。図１０（ａ）、図１０（ｂ）及び図１０（ｃ）を用いてこの温調ジャケット１３の詳細について以下に説明する。

【００５１】ブロックＢＬの少なくとも一面は、接する投影レンズ３の鏡筒外壁の曲率とほぼ同じ曲率を持っている。ブロックＢＬには液体ｆと投影レンズ３の鏡筒外壁との間で熱を伝達するために熱伝導率や比熱が高い材料、例えばアルミニウムや銅またはそれらの合金が好適である。また、このブロックＢＬには温度制御された液体ｆを流す流路として穴が複数本開けられている。この穴は滑らかな円筒状でも良いが、故意に表面粗さを粗くしたり、全長に渡ってネジ等の凹凸を持つ形状に加工することによって、温度制御された液体ｆとの接触面積を大きくすることができ、さらにこの穴を流れる液体ｆの状態を乱流とすることで熱交換効率を最大限に向上させることも可能である。

【００５２】さらに、この複数のブロックＢＬに開けた複数の穴を互いに柔軟性のあるチューブｐで連結している。このブロックＢＬ間のチューブｐでの連結には不図示の管継ぎ手を用いても良い。また図１０（ａ）～（ｃ）では、このチューブｐの連結面を、曲率を持った面に対して略直交する面に設けているが、例えばこの曲率面に対向する面を連結面として、隣接するブロックＢＬとＵ字状にチューブｐを連結しても良い。また、ブロックＢＬに開ける複数の穴の径をチューブｐの外径とほぼ同寸法に加工し、このチューブｐを直接このブロックＢＬの穴に接触するように圧挿入してもよい。穴に直接圧挿入することで、継ぎ手が不要となるばかりでなく、各ブロックＢＬ間の間隔を微調整することが簡単にでき、組立コストを低減できる利点がある。

【００５３】また、挿入後にチューブｐとブロックＢＬを互いに接着することで接触熱抵抗を極力少なくでき、熱交換効率を上げることができる。また、本実施例ではチューブｐとは別に各ブロックＢＬを連結シートｇで連結するように密着させており、各ブロックＢＬ間の距離をこの連結シートｇによって常に一定に保っている。投影レンズ３の鏡筒にこの温調ジャケット１３を装着する

際、この連結シートｇを投影レンズ３の鏡筒外壁に巻くように作業し、不図示のバンドなどで連結シートｇの両端を解除可能に締結することで、簡単かつ確実に温調ジャケット１３を被温度制御物体に密着させることが可能となる。

【００５４】また、この連結シートｇを構成することにより、各ブロックＢＬ間の間隔に対して連結させるチューブｐの長さを多少長めに設定することができ、それによってチューブｐの長さの寸法誤差を或る程度許容することができるため、温調ジャケット１３の組立てが簡単となり、また被温度制御物体への装着時に余計な力がチューブｐに掛からなくすることができ、チューブｐの破断や不図示の継ぎ手からのチューブｐの脱落が防止できる利点がある。また、この連結シートｇの構成材料の一つとして磁性体を用いれば、この吸着力によってブロックＢＬと投影レンズ３の鏡筒間の接触圧力を比較的均等に保つことができ、投影レンズ３の鏡筒全体を比較的均一な温度分布に制御することも可能である。

【００５５】また、ブロックＢＬと投影レンズ３の鏡筒外壁の互いに接触する両接触面の表面粗さが粗くなるほど接触熱抵抗が大きくなり、熱交換効率が低下してしまうが、この連結シートｇに比較的表面硬度の低い材料を用いることにより、ブロックＢＬと投影レンズ３の鏡筒外壁間の密着性を向上させることができ、熱交換効率の向上が期待できる。また、この連結シートｇの構成材料の一つに平面方向の熱伝導率が高いグラファイトシートを用いることにより、ブロックＢＬが接触していない連結シートｇ部分でも投影レンズ３の鏡筒との熱交換が期待でき、その結果、温調ジャケット１３の熱交換効率を向上させ、かつ投影レンズ３の鏡筒をより均一な温度分布に温度制御することが可能となる。

【００５６】次に、図１１（ａ）は本発明に係る温調ジャケットの第７の実施例を示す平面図、１１（ｂ）はその断面図、図１１（ｃ）は図１１（ａ）の背面図である。この第７の実施例は前記第６の実施例で用いた主熱伝導部材としてのブロックＢＬを板状体ＰＬに置き換えた点で異なる。即ち投影レンズ３の鏡筒外壁とほぼ同一の曲率を持つ板状体ＰＬを複数枚備え、このそれぞれの板状体ＰＬの外壁に温度制御された液体ｆの流路となる配管を複数個設ける。前記ブロックＢＬと同様にこの板状体ＰＬの材質はアルミニウムや銅またはそれらの合金が適当であり、曲げ加工によって比較的簡単に投影レンズ３の鏡筒外壁と同等の曲率を得ることができる。またそれらに金属管を溶接することで十分な接触面積を持った温度制御された液体ｆの流路を形成することが可能である。複数の板を連結し、温度制御された液体ｆの流路となるチューブｐの構成や、さらにそれぞれの板状体ＰＬを連結して密着させる連結シートｇ等の他の構成については前記第６の実施例と同様にすることが可能である。

【００５７】また、この主熱伝導部材としての板状体ＰＬは、気液二層の自己励振による熱輸送を利用した板状のループ型細管ヒートパイプ、またはグラファイトシートであってもよく、ループ型細管ヒートパイプを適用すれば、板状体ＰＬの温度分布をさらに均一にすることが可能となり、従って温度制御された液体ｆと投影レンズ３の鏡筒間の熱交換効率をさらに高めると共に、投影レンズ３の鏡筒の温度分布をより均一に保つことが可能となる。ちなみに板状体ＰＬのループ型細管ヒートパイプは板状体ＰＬの面内の一方向の熱輸送能力が高く、比較的取り付け姿勢によらず能力を発揮することが特徴となっている。従って、この熱輸送方向を板状体ＰＬの長手方向に取り、短辺方向に温調された液体ｆの流路となる配管を設ければ、よりこのループ型細管ヒートパイプの能力を十分に発揮させることが可能となる。

【００５８】また、実際の投影レンズ３の鏡筒は、全長にわたり均一な外径を持つ円筒形状やそれと円錐形状を組み合わせた形状である場合だけではなく、種々の外径を持つ円筒形状を重ね合わせた、凹凸のある形状となる場合もある。このような場合には、図１２に示すように投影レンズ３の鏡筒外壁の曲率とほぼ同じ曲率を少なくとも一面に設けたブロックＢＬを一列に複数個構成した帯状の温調ジャケット１３を複数個用い、個々の温調ジャケット１３の長さや複数個のブロックＢＬ間の間隔、さらにブロックＢＬに設けられた曲面の曲率はそれぞれ対応する投影レンズ３の鏡筒外径に合わせた寸法とすることで対応できる。この場合、個々の温調ジャケット１３を直列にチューブｐで連結させ、温度制御された液体ｆの出入り口は、全体で一つだけ設けてもよいし、また、個々の温調ジャケット１３それぞれに設けてもよい。また、この複数の帯状の温調ジャケット１３を用いる方法は、ブロックＢＬのみならず主熱伝導部材として前記の充填剤ｊとそれを封入する樹脂シートｓを用いた場合や、板状体ＰＬを用いた温調ジャケット１３でも適用できることは当然である。

【００５９】ここまで温調ジャケット１３を装着する対象を露光装置の投影レンズ３に絞って述べてきたが、投影レンズに限らず、測長用干渉系を支持する支柱の温調や干渉計用のレーザ光源の冷却、オフアクシス顕微鏡等種々の光学系の温調にも利用して好適である。図１３は温調対象物が干渉計用レーザ光源等のように概略直方体の場合に適用される温調ジャケット１３の一実施例を示す平面図である。この温調ジャケット１３は、凸字形のシートｓに蛇行させてチューブｐを配置し、レーザ光源底面及び射出口以外の４面を展開した形になっている。

【００６０】（露光装置の実施例）次に前述した実施例の熱交換装置を装着した投影レンズを搭載した走査型露光装置の実施例を、図１９を用いて説明する。鏡筒定盤９６は床または基盤９１からダンパ９８を介して支持されている。また鏡筒定盤９６は、レチクルステージ定盤

９４を支持すると共に、レチクルステージ９５とウエハステージ９３の間に位置する投影光学系９７を支持している。

【００６１】ウエハステージ９３は、床または基盤９１から支持されたステージ定盤９２上に支持され、ウエハを載置して位置決めを行う。また、レチクルステージ９５は、鏡筒定盤９６に支持されたレチクルステージ定盤９４上に支持され、回路パターンが形成されたレチクルを搭載して移動可能である。レチクルステージ９５上に搭載されたレチクルをウエハステージ９３上のウエハに露光する露光光は、照明光学系９９から発生される。

【００６２】なお、ウエハステージ９３は、レチクルステージ９５と同期して走査される。レチクルステージ９５とウエハステージ９３の走査中、両者の位置はそれぞれ干渉計によって継続的に検出され、レチクルステージ９５とウエハステージ９３の駆動部にそれぞれフィードバックされる。これによって、両者の走査開始位置を正確に同期させるとともに、定速走査領域の走査速度を高精度で制御することができる。投影光学系９７に対して両者が走査している間に、ウエハ上にはレチクルパターンが露光され、回路パターンが転写される。

【００６３】本実施例では、前述の実施例の熱交換装置を装着した投影レンズを用いているため、投影光学系等の表面を高精度に温度制御することが可能となり、高速・高精度な露光が可能となる。

【００６４】（半導体生産システムの実施例）次に、本発明に係る熱交換装置を備えた露光装置を用いた半導体デバイス（ＩＣやＬＳＩ等の半導体チップ、液晶パネル、ＣＣＤ、薄膜磁気ヘッド、マイクロマシン等）の生産システムの例を説明する。これは半導体製造工場に設置された製造装置のトラブル対応や定期メンテナンス、あるいはソフトウェア提供などの保守サービスを、製造工場外のコンピュータネットワークを利用して行うものである。

【００６５】図１４は全体システムをある角度から切り出して表現したものである。図中、１０１は半導体デバイスの製造装置を提供するベンダ（装置供給メーカ）の事業所である。製造装置の実例としては、半導体製造工場で使用する各種プロセス用の半導体製造装置、例えば、前工程用機器（露光装置、レジスト処理装置、エッチング装置等のリソグラフィ装置、熱処理装置、成膜装置、平坦化装置等）や後工程用機器（組立て装置、検査装置等）を想定している。事業所１０１内には、製造装置の保守データベースを提供するホスト管理システム１０８、複数の操作端末コンピュータ１１０、これらを結んでイントラネット等を構築するローカルエリアネットワーク（ＬＡＮ）１０９を備える。ホスト管理システム１０８は、ＬＡＮ１０９を事業所の外部ネットワークであるインターネット１０５に接続するためのゲートウェイと、外部からのアクセスを制限するセキュリティ機能

を備える。

【００６６】一方、１０２～１０４は、製造装置のユーザとしての半導体製造メーカの製造工場である。製造工場１０２～１０４は、互いに異なるメーカに属する工場であっても良いし、同一のメーカに属する工場（例えば、前工程用の工場、後工程用の工場等）であっても良い。各工場１０２～１０４内には、夫々、複数の製造装置１０６と、それらを結んでイントラネット等を構築するローカルエリアネットワーク（ＬＡＮ）１１１と、各製造装置１０６の稼動状況を監視する監視装置としてホスト管理システム１０７とが設けられている。各工場１０２～１０４に設けられたホスト管理システム１０７は、各工場内のＬＡＮ１１１を工場の外部ネットワークであるインターネット１０５に接続するためのゲートウェイを備える。これにより各工場のＬＡＮ１１１からインターネット１０５を介してベンダ１０１側のホスト管理システム１０８にアクセスが可能となり、ホスト管理システム１０８のセキュリティ機能によって限られたユーザだけにアクセスが許可となっている。具体的には、インターネット１０５を介して、各製造装置１０６の稼動状況を示すステータス情報（例えば、トラブルが発生した製造装置の症状）を工場側からベンダ側に通知する他、その通知に対応する応答情報（例えば、トラブルに対する対処方法を指示する情報、対処用のソフトウェアやデータ）や、最新のソフトウェア、ヘルプ情報などの保守情報をベンダ側から受け取ることができる。各工場１０２～１０４とベンダ１０１との間のデータ通信及び各工場内のＬＡＮ１１１でのデータ通信には、インターネットで一般的に使用されている通信プロトコル（ＴＣＰ／ＩＰ）が使用される。なお、工場外の外部ネットワークとしてインターネットを利用する代わりに、第三者からのアクセスができずにセキュリティの高い専用線ネットワーク（ＩＳＤＮなど）を利用することもできる。また、ホスト管理システムはベンダが提供するものに限らずユーザがデータベースを構築して外部ネットワーク上に置き、ユーザの複数の工場から該データベースへのアクセスを許可するようにしてもよい。

【００６７】さて、図１５は本実施形態の全体システムを図１４とは別の角度から切り出して表現した概念図である。先の例ではそれぞれが製造装置を備えた複数のユーザ工場と、該製造装置のベンダの管理システムとを外部ネットワークで接続して、該外部ネットワークを介して各工場の生産管理や少なくとも１台の製造装置の情報をデータ通信するものであった。これに対し本例は、複数のベンダの製造装置を備えた工場と、該複数の製造装置のそれぞれのベンダの管理システムとを工場外の外部ネットワークで接続して、各製造装置の保守情報をデータ通信するものである。図中、２０１は製造装置ユーザ（半導体デバイス製造メーカ）の製造工場であり、工場の製造ラインには各種プロセスを行う製造装置、ここで

は例として露光装置２０２、レジスト処理装置２０３、成膜処理装置２０４が導入されている。なお図１５では製造工場２０１は１つだけ描いているが、実際は複数の工場が同様にネットワーク化されている。工場内の各装置はＬＡＮ２０６で接続されてイントラネットを構成し、ホスト管理システム２０５で製造ラインの稼動管理がされている。

【００６８】一方、露光装置メーカ２１０、レジスト処理装置メーカ２２０、成膜装置メーカ２３０などベンダ（装置供給メーカ）の各事業所には、それぞれ供給した機器の遠隔保守を行うためのホスト管理システム２１１，２２１，２３１を備え、これらは上述したように保守データベースと外部ネットワークのゲートウェイを備える。ユーザの製造工場内の各装置を管理するホスト管理システム２０５と、各装置のベンダの管理システム２１１，２２１，２３１とは、外部ネットワーク２００であるインターネットもしくは専用線ネットワークによって接続されている。このシステムにおいて、製造ラインの一連の製造機器の中のどれかにトラブルが起きると、製造ラインの稼動が休止してしまうが、トラブルが起きた機器のベンダからインターネット２００を介した遠隔保守を受けることで迅速な対応が可能で、製造ラインの休止を最小限に抑えることができる。

【００６９】半導体製造工場に設置された各製造装置はそれぞれ、ディスプレイと、ネットワークインタフェースと、記憶装置にストアされたネットワークアクセス用ソフトウェアならびに装置動作用のソフトウェアを実行するコンピュータを備える。記憶装置としては内蔵メモリやハードディスク、あるいはネットワークファイルサーバーなどである。上記ネットワークアクセス用ソフトウェアは、専用又は汎用のウェブブラウザを含み、例えば図１６に一例を示す様な画面のユーザインタフェースをディスプレイ上に提供する。各工場で製造装置を管理するオペレータは、画面を参照しながら、製造装置の機種４０１、シリアルナンバー４０２、トラブルの件名４０３、発生日４０４、緊急度４０５、症状４０６、対処法４０７、経過４０８等の情報を画面上の入力項目に入力する。入力された情報はインターネットを介して保守データベースに送信され、その結果の適切な保守情報が保守データベースから返信されディスプレイ上に提示される。またウェブブラウザが提供するユーザインタフェースはさらに図示のごとくハイパーリンク機能４１０～４１２を実現し、オペレータは各項目の更に詳細な情報にアクセスしたり、ベンダが提供するソフトウェアライブラリから製造装置に使用する最新バージョンのソフトウェアを引出したり、工場のオペレータの参考に供する操作ガイド（ヘルプ情報）を引出したりすることができる。ここで、保守データベースが提供する保守情報には、上記説明した本発明に関する情報も含まれ、また前記ソフトウェアライブラリは本発明を実現するための最新のソフトウェアも提供する。

【００７０】次に上記説明した生産システムを利用した半導体デバイスの製造プロセスを説明する。図１７は半導体デバイスの全体的な製造プロセスのフローを示す。ステップ１（回路設計）では半導体デバイスの回路設計を行う。ステップ２（マスク製作）では設計した回路パターンを形成したマスクを製作する。一方、ステップ３（ウエハ製造）ではシリコン等の材料を用いてウエハを製造する。ステップ４（ウエハプロセス）は前工程と呼ばれ、上記用意したマスクとウエハを用いて、リソグラフィ技術によってウエハ上に実際の回路を形成する。次のステップ５（組み立て）は後工程と呼ばれ、ステップ４によって作製されたウエハを用いて半導体チップ化する工程であり、アッセンブリ工程（ダイシング、ボンディング）、パッケージング工程（チップ封入）等の組立て工程を含む。ステップ６（検査）ではステップ５で作製された半導体デバイスの動作確認テスト、耐久性テスト等の検査を行う。こうした工程を経て半導体デバイスが完成し、これを出荷（ステップ７）する。前工程と後工程はそれぞれ専用の別の工場で行い、これらの工場毎に上記説明した遠隔保守システムによって保守がなされる。また前工程工場と後工程工場との間でも、インターネットまたは専用線ネットワークを介して生産管理や装置保守のための情報がデータ通信される。

【００７１】図１８は上記ウエハプロセスの詳細なフローを示す。ステップ１１（酸化）ではウエハの表面を酸化させる。ステップ１２（ＣＶＤ）ではウエハ表面に絶縁膜を成膜する。ステップ１３（電極形成）ではウエハ上に電極を蒸着によって形成する。ステップ１４（イオン打込み）ではウエハにイオンを打ち込む。ステップ１５（レジスト処理）ではウエハに感光剤を塗布する。ステップ１６（露光）では上記説明した露光装置によってマスクの回路パターンをウエハに焼付露光する。ステップ１７（現像）では露光したウエハを現像する。ステップ１８（エッチング）では現像したレジスト像以外の部分を削り取る。ステップ１９（レジスト剥離）ではエッチングが済んで不要となったレジストを取り除く。これらのステップを繰り返し行うことによって、ウエハ上に多重に回路パターンを形成する。各工程で使用する製造機器は上記説明した遠隔保守システムによって保守がなされているので、トラブルを未然に防ぐと共に、もしトラブルが発生しても迅速な復旧が可能で、従来に比べて半導体デバイスの生産性を向上させることができる。

【００７２】

【発明の効果】以上のように本発明によれば、温度制御された液体を利用して被温度制御対象物の温度制御を行う物体温度調節用熱交換装置において、この液体と被温度制御対象物間の熱交換を行う手段として、温度制御された液体を流す流路と、温度制御された液体と被温度制御対象物との間で熱を伝達する熱伝導部材を備え、かつ

この流路と熱伝導部材の一部または全部が一定の柔軟性を持った着脱可能な温調ジャケットを用いることにより、円筒や円錐形状を持つ投影光学系はもとより、複雑な凹凸表面や微妙な曲率形状を持つ被温度制御対象物に対して、熱伝導部材をその側壁に十分密着させることが可能となり、良好な熱交換性能を得ることが可能となり、所定の温度制御性能を満足することが可能となった。これを投影露光装置の投影光学系の温度制御やアライメントシステム及び干渉計測長システムに係る熱源等の温度制御に適用することにより、高精度の結像性能や重ね合わせ精度を得ることが可能となった。また、この温調ジャケットは平面展開が可能であることから、被温度制御対象物からの着脱が容易に行える利点があり、被温度制御対象物の修理やメンテナンスに掛かる時間を大幅に短縮することが可能となった。

【００７３】またさらに製造工程中での投影光学系の精密な温度管理が可能となり、製造工程中の投影レンズ単体の温度状態と投影露光装置本体に組み込んだ後の投影レンズの温度状態をほぼ同一にすることが可能となるため、製造工程中に調整して追い込んだ投影レンズ性能を本体上でも維持することが可能となり、投影レンズ製造の歩留まりが向上し、さらに安定して高い像性能を持つ投影露光装置の製造が可能となった。

【図面の簡単な説明】

【図１】　本発明に係る物体温度調節用熱交換装置の温調ジャケットを露光装置の投影レンズに装着した場合の第１の実施例を示す斜視図である。

【図２】　（ａ）は本発明の第１の実施例に係る温調ジャケットを示す平面図、（ｂ）はその断面図である。

【図３】　本発明の第２の実施例に係る物体温度調節用熱交換装置の温調ジャケットを示す平面図である。

【図４】　（ａ）は本発明の第３の実施例に係る物体温度調節用熱交換装置の温調ジャケットを示す平面図、（ｂ）はその断面図である。

【図５】　本発明の第４の実施例に係る物体温度調節用熱交換装置の温調ジャケットを示す平面図である。

【図６】　本発明に係る物体温度調節用熱交換装置の温調ジャケットを露光装置の投影レンズに装着した場合の第５の実施例を示す斜視図である。

【図７】　本発明の第５の実施例に係る温調ジャケットの第１変形例を示す平面図である。

【図８】　本発明の第５の実施例に係る温調ジャケットの第２変形例を示す平面図である。

【図９】　本発明に係る物体温度調節用熱交換装置の温調ジャケットを露光装置の投影レンズに装着した場合の第６の実施例を示す斜視図である。

【図１０】　（ａ）は本発明の第６の実施例に係る温調ジャケットを示す平面図、（ｂ）はその断面図、（ｃ）は（ａ）の背面図である。

【図１１】　（ａ）は本発明の第７の実施例に係る物体温度調節用熱交換装置の温調ジャケットを示す平面図、（ｂ）はその断面図、（ｃ）は（ａ）の背面図である。

【図１２】　（ａ）は本発明の第８の実施例に係る物体温度調節用熱交換装置の温調ジャケットを示す平面図、（ｂ）はその背面図である。

【図１３】　本発明の第９の実施例に係る物体温度調節用熱交換装置の温調ジャケットを示す平面図である。

【図１４】　本発明に係る物体温度調節用熱交換装置を使用した露光装置を用いた半導体デバイスの生産システムをある角度から見た概念図である。

【図１５】　本発明に係る物体温度調節用熱交換装置装置を使用した露光装置を用いた半導体デバイスの生産システムを別の角度から見た概念図である。

【図１６】　ユーザインタフェースの具体例である。

【図１７】　デバイスの製造プロセスのフローを説明する図である。

【図１８】　ウエハプロセスを説明する図である。

【図１９】　本発明に係る熱交換装置を用いた露光装置の実施例を示す概略図である。

【図２０】　従来の半導体露光装置の概略図である。

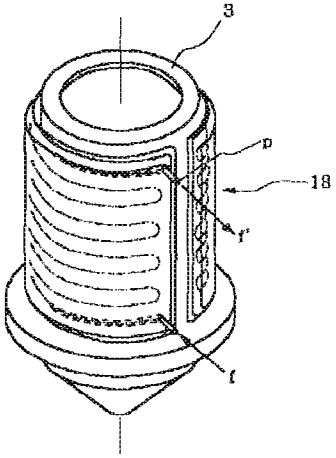
【符号の説明】

１：照明光学系、２：レチクル、３：投影レンズ、４：ウエハ、５：ウエハステージ、６：オフアクシス顕微鏡、７：基準ミラー、８：レーザ干渉計、９：レーザ干渉計取り付け支柱、１０：レーザ干渉計用光源、１１：空調空気吹き出し口、１２：露光装置本体構造体、１３：温調ジャケット、ｆ，ｆ１，ｆ２，ｆ’，ｆ１’，ｆ２’：液体（熱媒体）、ｊ：充填剤、ｐ，ｐ１，ｐ２：チューブ、ｓ：樹脂シート、ＢＬ：ブロック、ＰＬ：板状体、９１：基盤、９２：ステージ定盤、９３：ウエハステージ、９４：レチクルステージ定盤、９５：レチクルステージ、９６：鏡筒定盤、９７：投影光学系、９８：ダンパ、９９：照明光学系、１０１：ベンダの事業所、１０２，１０３，１０４：製造工場、１０５：インターネット、１０６：製造装置、１０７：工場のホスト管理システム、１０８：ベンダ側のホスト管理システム、１０９：ベンダ側のローカルエリアネットワーク（ＬＡＮ）、１１０：操作端末コンピュータ、１１１：工場のローカルエリアネットワーク（ＬＡＮ）、２００：外部ネットワーク、２０１：製造装置ユーザの製造工場、２０２：露光装置、２０３：レジスト処理装置、２０４：成膜処理装置、２０５：工場のホスト管理システム、２０６：工場のローカルエリアネットワーク（ＬＡＮ）、２１０：露光装置メーカ、２１１：露光装置メーカの事業所のホスト管理システム、２２０：レジスト処理装置メーカ、２２１：レジスト処理装置メーカの事業所のホスト管理システム、２３０：成膜装置メーカ、２３１：成膜装置メーカの事業所のホスト管理システム、４０１：製造装置の機種、４０２：シリアルナンバー、４０３：トラブルの件名、４０４：発生日、４０

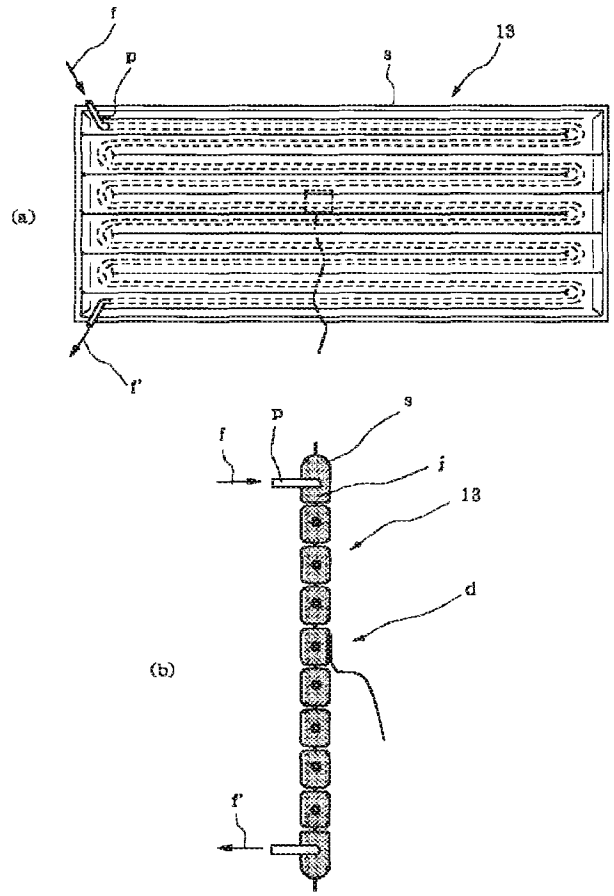
25　　26

５：緊急度、４０６：症状、４０７：対処法、４０８：＊　＊経過、４１０，４１１，４１２：ハイパーリンク機能。

【図１】



【図２】



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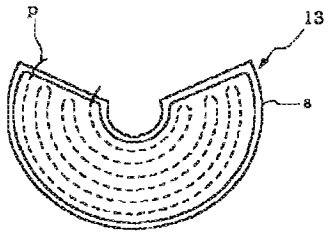
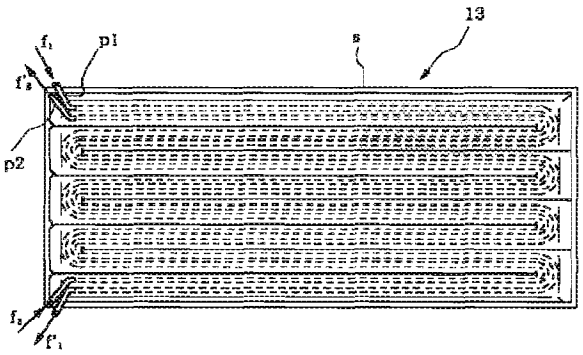
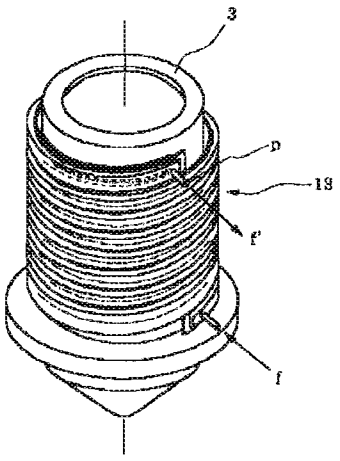


【図３】



【図６】



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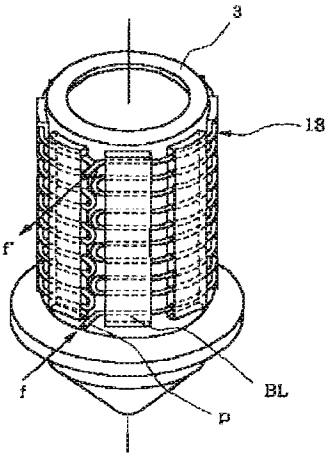
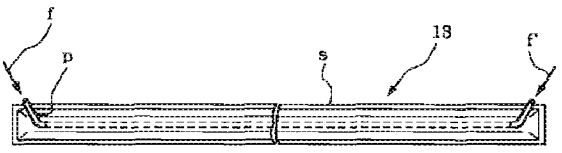


【図７】



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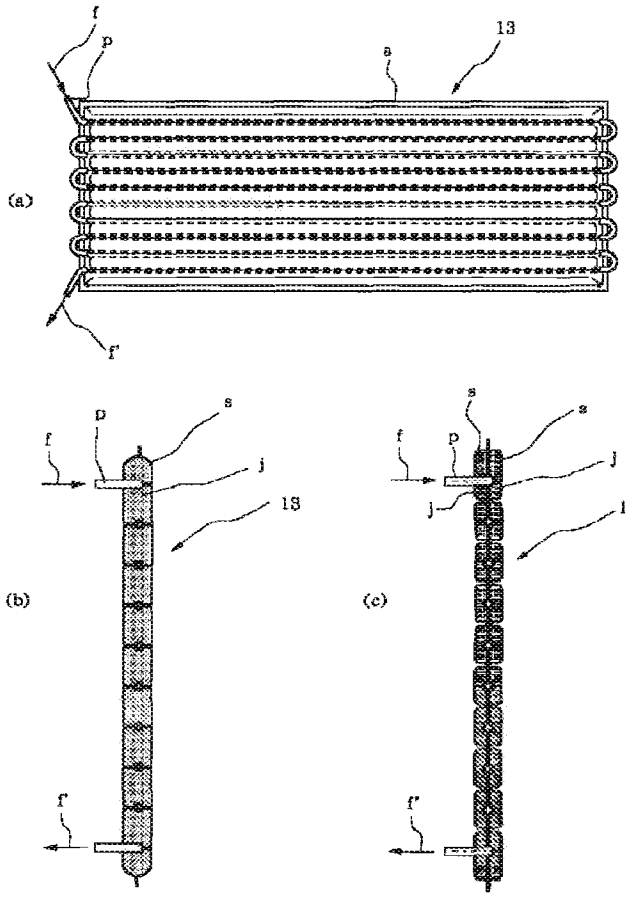
f
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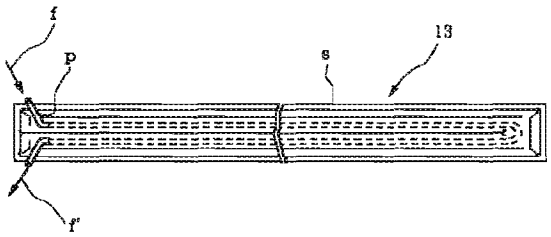
s
13
(a)
f'
(b)
j
18
(c)

【図８】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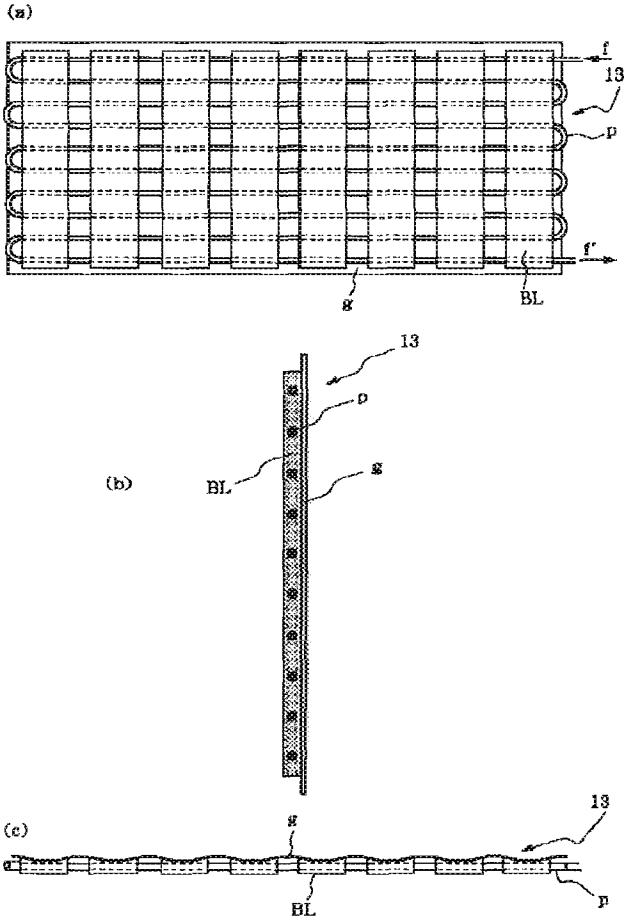
【図１０】


(a)
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f'
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(b)
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p
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g
(c)
g
13
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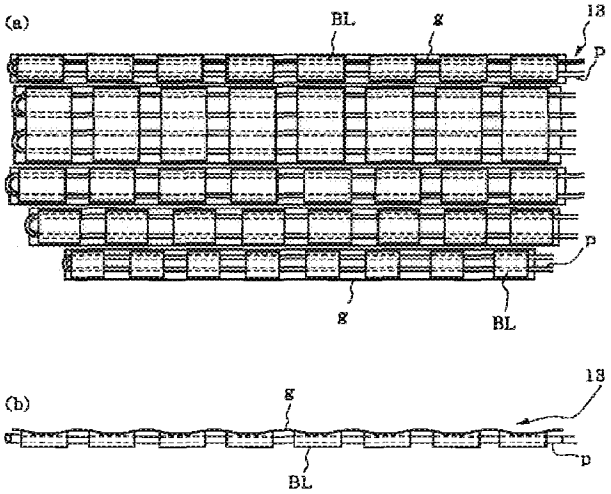
【図１２】


(a)
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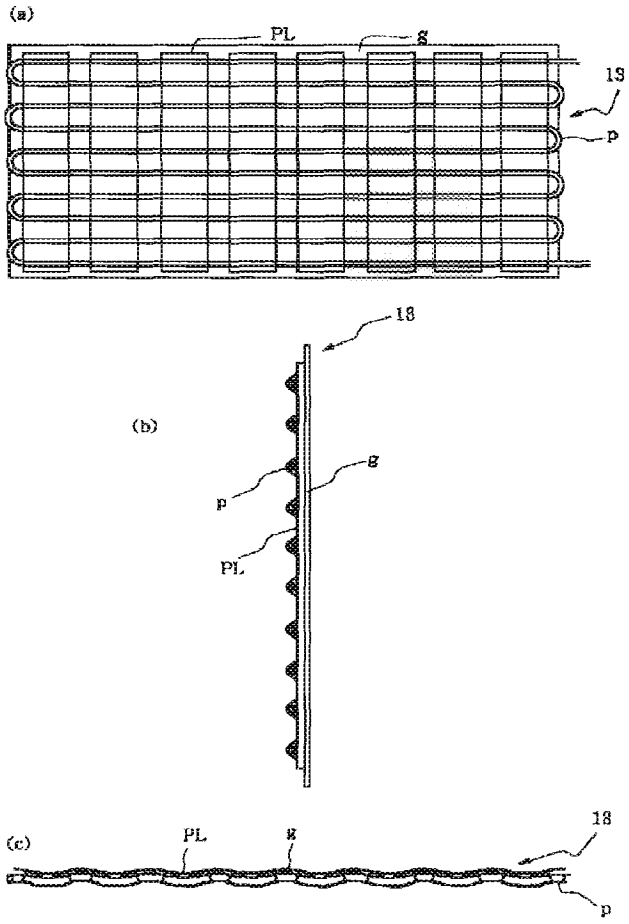
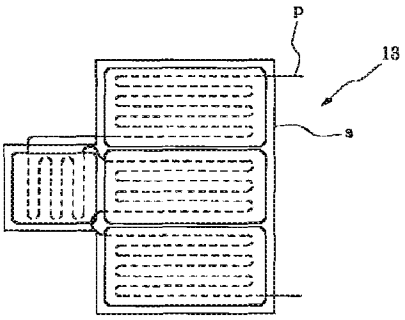
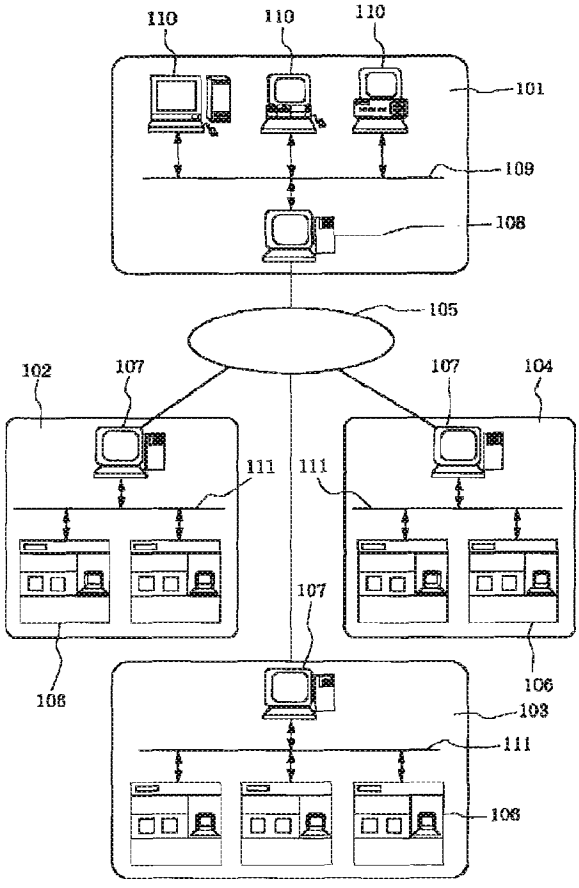
【図１１】



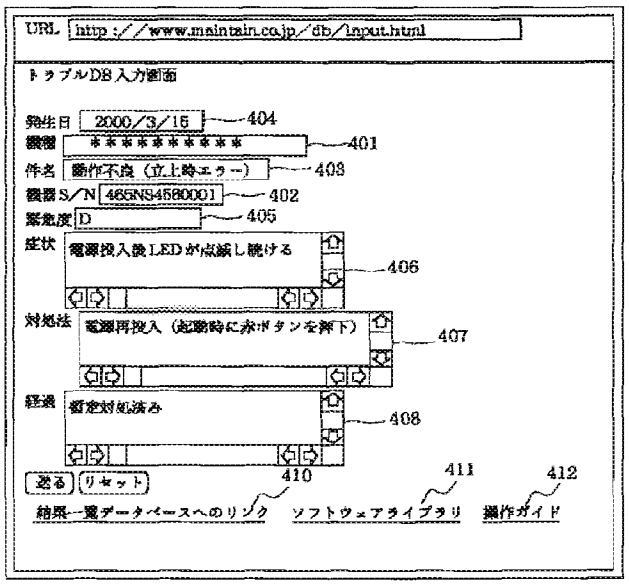
【図１３】



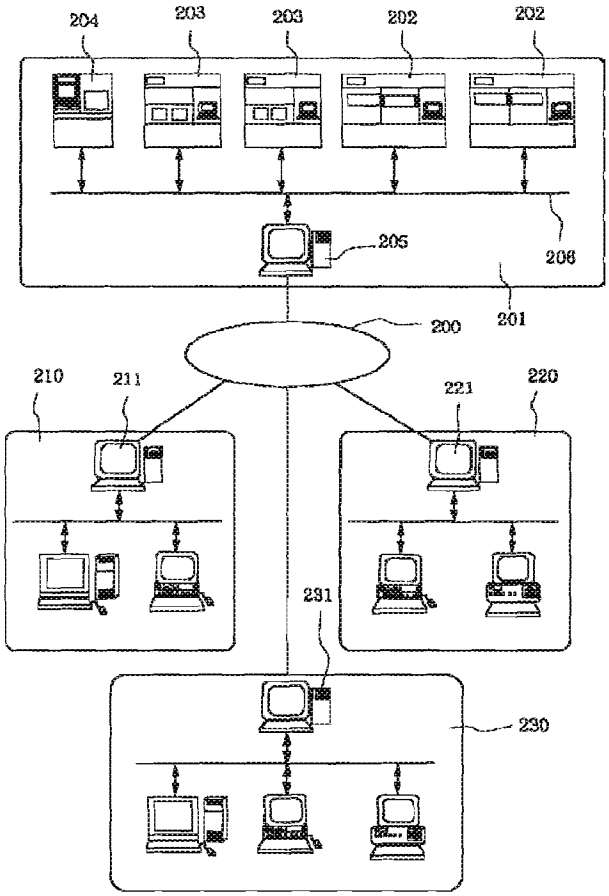
【図１４】



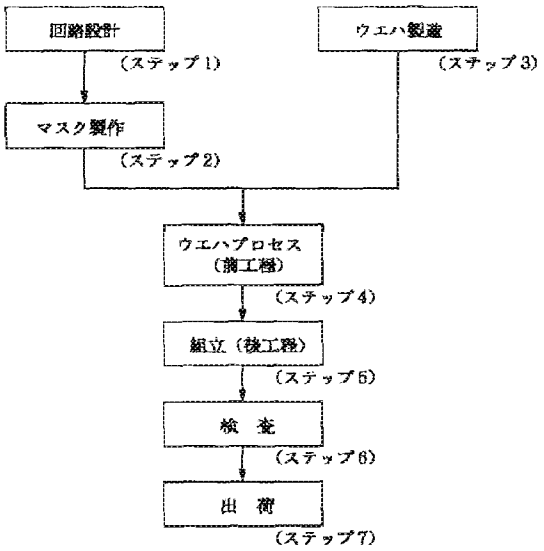
【図１６】



【図１５】

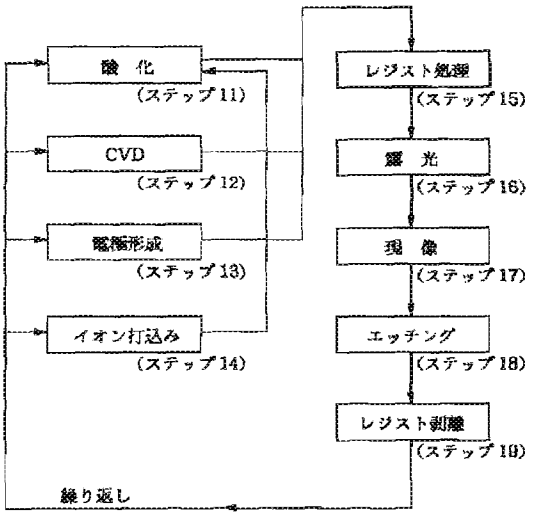


【図１７】



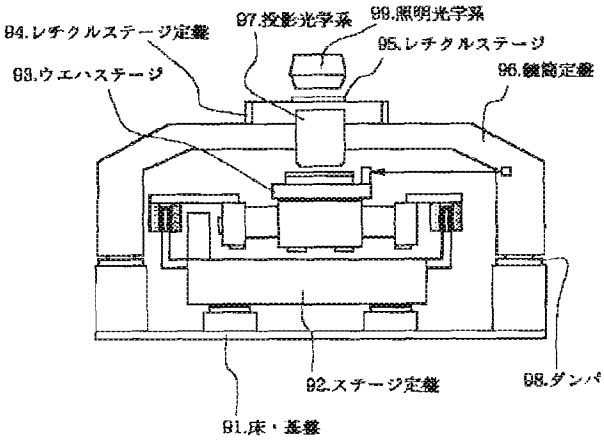
半導体デバイス製造フロー

【図１８】



ウエハプロセス

【図１９】



【図２０】